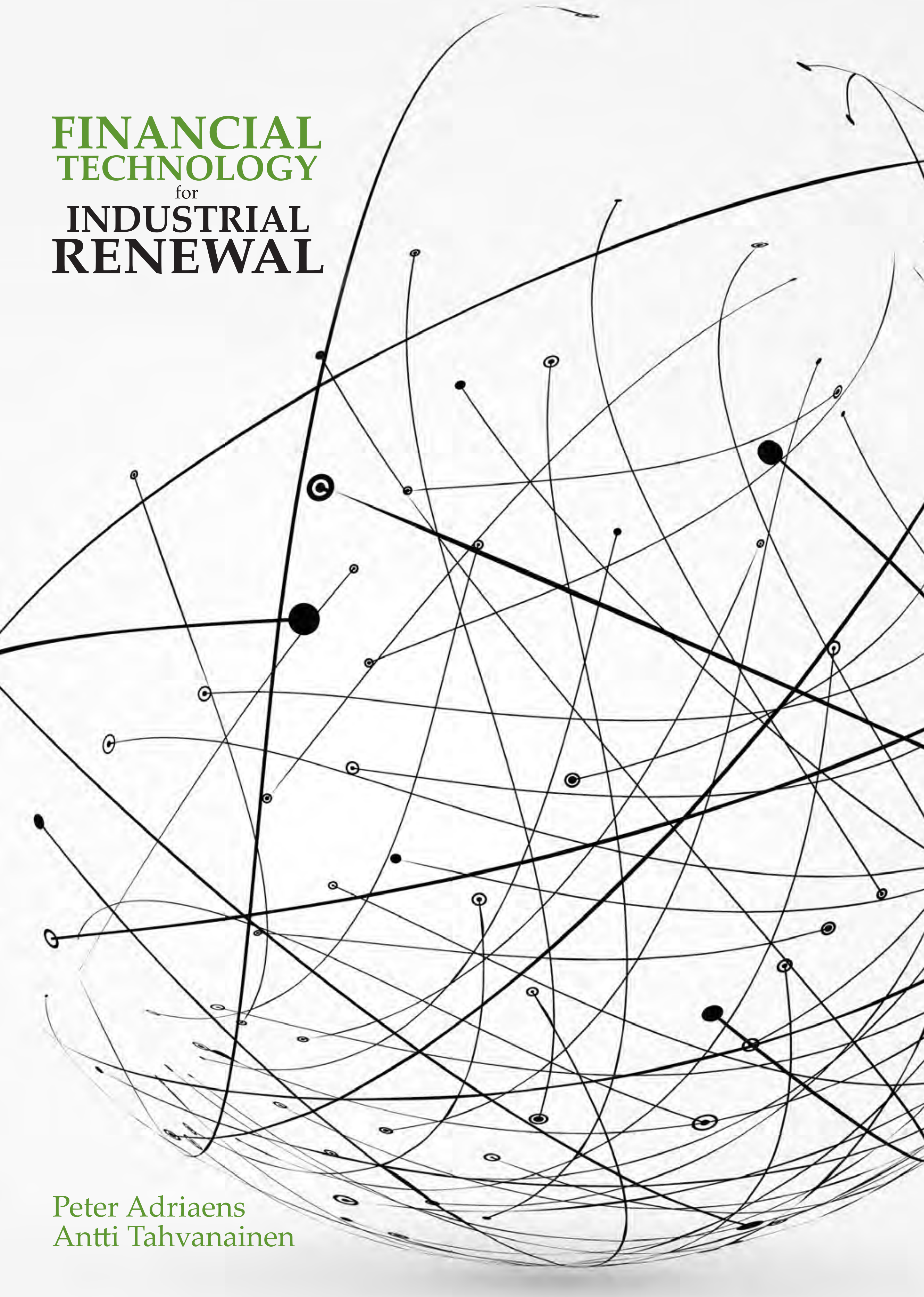
FINANCIAL TECHNOLOGY for INDUSTRIAL RENEWAL



Peter Adriaens
Antti Tahvanainen

FINANCIAL TECHNOLOGY for INDUSTRIAL RENEWAL

Peter **Adriaens** *and* Antti **Tahvanainen**

Elinkeinoelämän tutkimuslaitos Etla

Elinkeinoelämän tutkimuslaitos – Etla
The Research Institute of the Finnish Economy – Etla

Series B272
ISSN 0356-7443
ISBN 978-951-628-669-6 (printed)
ISBN 978-951-628-670-2 (pdf)

Publisher: Taloustieto Oy
Cover picture: shutterstock.com
Printed in: Next Print Oy, Helsinki, 2016

Suggested citation:
Adriaens, Peter, **Tahvanainen**, Antti (2016).
Financial Technology for Industrial Renewal.
Helsinki: Taloustieto Oy (ETLA B272). http://pub.etla.fi/ETLA-B272.pdf

FINANCIAL TECHNOLOGY

"...also known as FinTech, is an economic industry comprised of firms that use information technology to make financial services more efficient. Initially reserved for financial transactions, the term has been expanded to broader applications of technology – from front-end consumer products, to digital platforms for fund design and management, and new paradigms such as block chain technology."

for

INDUSTRIAL RENEWAL

"The refocusing or transitioning of an economy and its industry actors to stimulate growth, usually through technology and knowledge innovation by leveraging existing assets, trade relationships, and skill sets. Renewal explicitly invokes the emergence of new industries as the result of investments in the real economy, at the company, cluster, national or regional level."

Acknowledgements

The contents of this book represent the fruits of two and a half years of exciting work conducted in collaboration between the Research Institute of the Finnish Economy (Etla) and the University of Michigan, Ross School of Business, under the auspices of the Tekes-funded Finnish Distinguished Professor Project "Towards Value Capture and Investability – A Roadmap for Finnish Cleantech".

In addition to Tekes (the Finnish Funding Agency for Innovation), we would like to recognize support from Ladec Ltd., the Finnish Innovation Fund (Sitra), CLIC Innovation Ltd., and RYM Ltd. for the generous financial sponsorship of the project. Special thanks go also to Cleantech Invest Ltd., the Centre for Environment and Energy (CEE) at the University of Oulu, and the Ministry for Employment and the Economy for promoting the project.

We have enjoyed the guidance of an excellent expert steering committee. Thank you for your feedback, time commitments, and contributions over the last 30 months Nina Harjula (NIA), Tommy Jacobsson (CLIC Innovation), Sami Tuhkanen (Sitra), Ari Ahonen (RYM), Tarja Teppo (Cleantech Invest), Henri Grundsten (Industry Investment), Pekka Tervonen (CEE), Urpo Hautala (Ministry of Finance, FIN), Pekka Pesonen (Tekes), Kaisu Annala (Ministry for Employment and the Economy, FIN).

We are deeply in debt to a diverse and dedicated international team of developers, analysts and co-authors, who helped along the way with company analysis, product improvement, and writing updates on and digesting learnings from the project.

The development of the Multi-Asset Renewal Fund – and the processes that enable its structuring – were very complex and multi-dimensional. For the initial ideation around the structure of the fund, we thank Sven Adriaens (Michigan State University, Broad School of Business) as our Lego® Serious Play® facilitator, and an engaged team of participants, including Timo Seppälä (Aalto University and Etla), Tim Faley (Professor, University of the Virgin Islands), Alexandre Mercier (Hudson & Yorke, London, UK), Weidi Sun (University of Michigan), and Nelli Valmari (Etla). For help with analysis of emerging businesses, SMEs and corporate enterprises using the Keystone Compact® suite of tools, a heartfelt thanks to Alexandre Mercier, Weidi Sun, Annu Kotiranta (Etla), Juri Mattila (Etla), Nicole Bettè (University of Michigan), Nic Miller (University of Michigan), Joona Widgrén (Etla), Niklas Lundell (Etla), and Kirsi Raukola (Etla). Dimitris Assanis (University of Michigan) and Yuan Liu (University of Michigan) were instrumental in financial network analysis and ETF portfolio structuring. Thanks for the design of the storyboard video for the fund go to the dedication of Sven Adriaens, Nic Miller, and Maggie Hire. Dimitris Assanis lent his voice as the narrator. Last but not least, the financial risk and return analysis of the fund structure was led by a strong Multidisciplinary Action Program (MAP) finance team from the University of Michigan – Stephen M. Ross School of Business, with support from Agnieszka Soporek (Haaga-Helia University, Helsinki). Thanks for your commitment, Bradford Lynch, Guilherme Teruo Takeo Ishihara, Dave Spallina, Morgan Nagy, Christopher Giovine, and Sanmeet Sajuja.

Many thanks go to Annu Kotiranta and Maria Ritola (Demos Helsinki) for taking the lead on writing the Finnish Cleantech story, and to Tuomo Nikulainen (Omniata Inc, San Francisco, USA) for developing the initial inventory of small and medium enterprises engaged in Cleantech. Mika Pajarinen deserves our appreciation for his support with finding reams of company financial data required for this project and Kimmo Aaltonen is recognized for his professional touch in laying out the book. Both Kirsti Jalaistus and Markku Maula provided us with invaluable administrative support throughout this complex and highly networked endeavor.

The development work of the last two and a half years would not have been feasible without constant feedback from the great number of experts and practitioners at various financial institutions, economic development organizations, dissemination forums and companies. We want to salute HSBC (London, UK), Deutsche Bank (London, UK), P80 Group Foundation (Little Rock, Arkansas, USA), Legg Mason Global Asset Management (London, UK), Estlander & Partners (Vaasa, Finland), Capricorn Venture Partners (Leuven, Belgium), RobecoSAM (Zürich, Switzerland), Total Energy Ventures, MSCI ESG Research (New York, NY), CDP (London, UK), South Pole Carbon Asset Management (Zürich, Switzerland), KBC Bank (Brussels, Belgium), swisscleantech (Bern, Switzerland), the Global Cleantech Cluster Association (Bern, Switzerland), Cleantech San Diego (San Diego, USA), NextEnergy (Dearborn, Michigan, USA), Écotech Québec (Montreal, Quebec, Canada), Flanders Cleantech Association (Berchem, Belgium), Washington Clean Technology Alliance (Seattle, Washington, USA), Taiwan Green Trade Project Office (Taipei, Taiwan), Chinese Society for Sustainable Development (Huangzhou, China), Cleantech Forum Europe (Stockholm, Sweden), i-SUP 2014 (Brussels, Belgium), and Nordic Cleantech Open (Trolleholm, Sweden). Many partners and stakeholder organizations in Finland were consulted and engaged, including Finnish Venture Capital Association, Nordea, OP, Ilmarinen, Elo, Asiakastieto, State Pension Fund VER, Finnish Industry Investment TESI, Juuri Partners, Tekes, Sitra, Finnvera, Finpro, Ministry of Finance (FIN), Ministry for Employment and the Economy (FIN), Demos Helsinki, and Cleantech Venture Day (Lahti, Finland).

We have also had the luxury of benefiting from a highly knowledgeable and experienced group of international advisors, who have provided us many times with a shortcut to insights and support when our own efforts were at a fork in the road. Thank you for your ideas and contributions Christian Häuselmann (swisscleantech and Global CleanTech Cluster Association), Timothy Faley (University of the Virgin Islands, USA), David Brophy (University of Michigan, USA), Martti Kulvik (Etla), Fabian Sepulveda (Courage Ventures), Vesa Vihriälä (Etla), Petri Rouvinen (Etla), Ari Hyytinen (University of Jyväskylä, Finland), Ahti Salo (Aalto University), Teija Lahti-Nuuttila (Finnish Funding Agency for Innovation), Raine Hermans (Finnish Funding Agency for Innovation), Mari Pantsar (Sitra), and Carine van Hove (Flanders CleanTech Association).

Lastly, a personal note.

The FiDiPro appointment required a commitment of 12 wonderful months in Helsinki over a two-and-half year period. Personally and professionally enriching as it was, this would not have been possible without the dedication, love, and patience of my wife and life partner, Iris. She was single-parenting to Sven and Noelle, and a beacon of support for me during the dark Finnish winters. Despite missed sporting and music events, being disconnected from day-to-day family life, and the transitional state of my living out of a suitcase, their support was key to making this a resounding success. Our shared family experiences in Finland couldn't have been more exquisite: exploring cultural sites by bike, traveling to the Arctic, and a month of working and living side-by-side with my son. Irreplaceable. All my gratitude, thanks and love.

To the staff and colleagues at Etla: You are fantastic hosts and have become dear friends. Thanks for making me feel part of the team, Petri (Rouvinen). Jyrki (Ali-Yrkkö), the concept of 'office-planking' and one-armed pushups is something to carry forward to Michigan. For a quick quip and laugh, digital platform expert Timo (Seppälä) was never lost for words and opinions. Our resident block chain technology guru, Juri (Mattila), is the social glue for the office. Annu (Kotiranta), I enjoyed parking myself in your doorway at the beginning of my day. A very special thanks goes to my dear friend Martti (Kulvik). From day one,

you went out of your way to engage me in local wine tasting events, invited me to the Helsinki Symphony Orchestra, and took us out on the water on your boat. You have this work-life balance thing figured out. I will never forget the cultural-boating event you organized for our Michigan-Etla team in the Summer of 2015, culminating in a gathering at your family cottage on the island.

Peter Adriaens.

The journey this book concludes was one of those that have the potential to change lives. The multitude of inspiring and encouraging encounters, the constant exposure to a myriad of refreshingly different opinions, shoals of seemingly impossible obstacles navigated and the volumes of new lessons learnt have given me the courage to step way beyond the comfort zone and push for what truly matters if a change for the better is what we want. It is really just three things: action, action and action! Everything is possible if you put your back into it and relentlessly try. Thankfully, I didn't have to face the scary bits on my own. Like on all my previous adventures into the unknown, my wife Tiltu was there, steadfast, for support everytime things got a little desperate. She also shared all the fun along the way. As you well know, journeys – and memories – are best shared. Thank you! We keep going to the moon and back.

Antti Tahvanainen.

Contributions by Chapter

Chapter 1 Peter Adriaens and Antti Tahvanainen

Chapter 2 Adapted from Kotiranta, A., Tahvanainen, A.-J., Adriaens, P. & Ritola, M. (2015). From Cleantech to Cleanweb – The Finnish Cleantech Space in Transition. ETLA Reports No 43. Helsinki, Finland.

Chapter 3 Peter Adriaens and Antti Tahvanainen; original statistics by Annu Kotiranta, ecosystems maps by Dimitris Assanis

Chapter 4 Peter Adriaens and Antti Tahvanainen; original statistics by Annu Kotiranta

Chapter 5 Peter Adriaens and Antti Tahvanainen

Chapter 6 Peter Adriaens and Antti Tahvanainen

Chapter 7 Peter Adriaens based on a report for the Ross School of Business – University of Michigan Multidisciplinary Action Projects (MAP) program, authored by Christopher Giovine, Guilherme Teruo Takeo Ishihara, Bradford Lynch, Morgan Nagy, Sanmeet Sanjuja, and Dave Spallina.

Chapter 8 Peter Adriaens and Antti Tahvanainen

Contents

List of Abbreviations

AI	Artificial Intelligence
AIFM	Alternative Investment Fund Manager
AUM	Assets Under Management
BICS	Bloomberg Industry Classification System
CA	Capabilities Adjacency
CAPM	Capital Asset Pricing Model
CBE	Current Business Expansion
CDS	Credit Default Swap
CETA	Comprehensive Economic and Trade Agreement
CIO	Chief Investment Officer
CRP	Country Risk Premium
DAAS	Data-as-a-Service
DE	Debt-to-Equity Ratio
EBIT	Earnings Before Interest and Taxes
EBITDA	Earnings Before Interest, Taxes, Depreciation and Amortization
EC	European Commission
EFSI	European Fund for Strategic Investment
EIB	European Investment Bank
ERP	Equity Risk Premium
ESG	Environmental, Social and Governance
ETF	Exchange Traded Fund
ETP	Exchange Traded Product
ETSI	European Telecommunications Standards Institute
EU	European Union
EVCA	European Venture Capital Association
FDI	Foreign Direct Investment
FNA	Financial Network Analytics
FTE	Full Time Employee
FVM	Fair Value Measurement
GCCA	Global CleanTech Cluster Association
GDP	Gross Domestic Product
GICS	Global Industry Classification System
GP	General Partner
GPS	Global Positioning System
GVC	Global Value Chain
HCA	Hierarchical Cluster Analysis
ICT	Information and Communications Technology
IE	Interest Expense
IEA	International Energy Agency
IEC	International Electrotechnical Commission
IG	Investment Grade

IISD	International Institute for Sustainable Development
IOT	Internet of Things
IPO	Initial Public Offering
IRR	Internal Rate of Return
ISIC	International Standard Industrial Classification
IT	Information Technology
ITS	Intelligent Transportation System
LED	Light Emitting Diode
LOB	Line of Business
LP	Limited Partner
LRP	Liquidity Risk Premium,
LTIF	Long-Term Investment Fund
M&A	Mergers and Acquisitions
MA	Market Adjacency
MaaS	Mobility-as-a-Service
MARF	Multi-Asset Renewal Fund
MM	Mid-Market companies
MNE	Multi-National Enterprises
NACE	General Industrial Classification of Economic Activities in the European Communities
NAICS	North American Industry Classification System
NAV	Net Asset Value
NGO	Non-Governmental Organization
NPV	Net Present Value
OECD	Organization for Economic Co-operation and Development
PCA	Principal Components Analysis
PE	Private Equity
PPA	Power Purchase Agreements
PRI	Principles for Responsible Investment
PVC	Positioning for Value Capture
R&D	Research and Development
REACH	Registration, Evaluation, Authorization and Restriction of Chemicals
REIT	Real Estate Investment Trust
RI	Responsible Investments
ROA	Return on Assets
ROC	Receiver Operating Characteristic
ROCE	Return on Capital Employed
ROE	Return On Equity
ROI	Return in Investment
SAAS	Software-as-a-Service
SASB	Sustainability Accounting Standards Board
SME	Small and Medium Enterprises
SNA	Social Network Analysis
SPLC	Supply Chain

UN	United Nations
USDE	United States Department of Education
USEDA	United States Economic Development Administration
VaR	Value-at-Risk
VC	Venture Capital
WEF	World Economic Forum
WRI	World Resources Institute
XAAS	Everything-as-a-Service
YTC	Yield to Call
YTM	Yield to Maturity
YTW	Yield to Worst

VISION STATEMENT

Our vision is to design a new investment fund instrument. It leverages capital commitments of both large institutional investors and economic developers for fueling the renewal of legacy industries and the growth of emerging industrial ecosystems. By pooling different financial asset classes – such as risk debt, growth equity and corporate bonds – in thematic portfolios, this instrument will address the distinct financial needs of startups, SMEs and enterprises alike.

The timing is right today because (i) institutional investors – frustrated with the dwindling performance of traditional investment models – are on the lookout for financial innovations to meet fiduciary duties and enhance returns; (ii) economic developers around the world are in dire need of efficient means to turn around lackluster economies and to promote industrial renewal; and (iii) growth companies – having limited access to traditional growth debt in the wake of the latest financial crisis – are searching for alternative financing sources to fuel their businesses in promising new industrial ecosystems.

It is challenging to achieve because (i) the institutional investment domain views innovative investment instruments with risk-averse skepticism; (ii) the regulatory thicket governing financial markets is hard to navigate for new investment vehicles; (iii) the identification of emerging industrial ecosystems with true economic growth potential and ability to provide sustainable financial returns is a complex undertaking; and (iv) the management of a multi-asset investment fund requires both a very broad and in-depth professional skillset few finance professionals are endowed with.

By working with asset managers, institutional investors, economic development agencies and other practitioners, we will make this vision real by developing a process for (i) identifying promising new industrial ecosystems, (ii) assessing the respective companies for their investment grade, (iii) designing the structure and investment thesis for a Multi-Asset Renewal Fund (MARF), and (iv) establishing the fund's investment rating to promote its adoption in the financial markets.

Intro

1

Innovation in Financial Technology Drives Industrial Renewal

Desperate times call for desperate measures. With his renowned aphorism, Hippocrates as a physician referred to the necessity of inventive, even radical forms of therapy in combating vicious ailments. Little did he know how throughout the millennia his wisdom would find justification in much broader contexts. Ours is surely one of them.

As we write this, the global economy is in the throes of widespread political and economic convulsions: Europe is struggling with its lackluster competitiveness and the corresponding effects on unemployment; China has lost its momentum as an economic powerhouse and growth driver; the plummeting oil price has made life for oil producing economies a living nightmare; digitalization and artificial intelligence are threatening to wipe out the jobs of half the world's population; and Russia is defiantly clawing at old battle scars, sending widespread ripples throughout its surrounding economic and political systems.

In collaboration with practitioners, we have developed an integrated set of analytical tools and financial innovations for the promotion of renewal

The world is at a turning point in many ways, there is no question. Successful best practices and business models of the last two decades suddenly hemorrhage relevance. As the effects of digital change, demographic forces, political momentum and ecological concerns are rewriting the rules of global economic competition, individuals, companies, and governments are on the lookout for the appropriate strategies and tools to harness existing and emerging resources for the much needed industrial renewal.

With this book, we want to help economic developers, financiers and companies achieve this goal. In collaboration with practitioners, we have developed an integrated set of analytical tools and financial innovations for the promotion of renewal in one thematic industrial ecosystem at a time. Let us illuminate and take a closer look at the vision statement on the opposite page.

Our vision is to...

…design a novel investment fund instrument that will pool capital commitments of large institutional investors into thematic, multi-asset funds to fuel the renewal and growth of the real economy while providing attractive returns for the investors.

To save you from drowning in jargon and technical cant, let us immediately demystify what we just meant with terminology such as "institutional investors", "thematic", and "multi-asset funds". At the same time, let us also explain what is so disruptive about this vision.

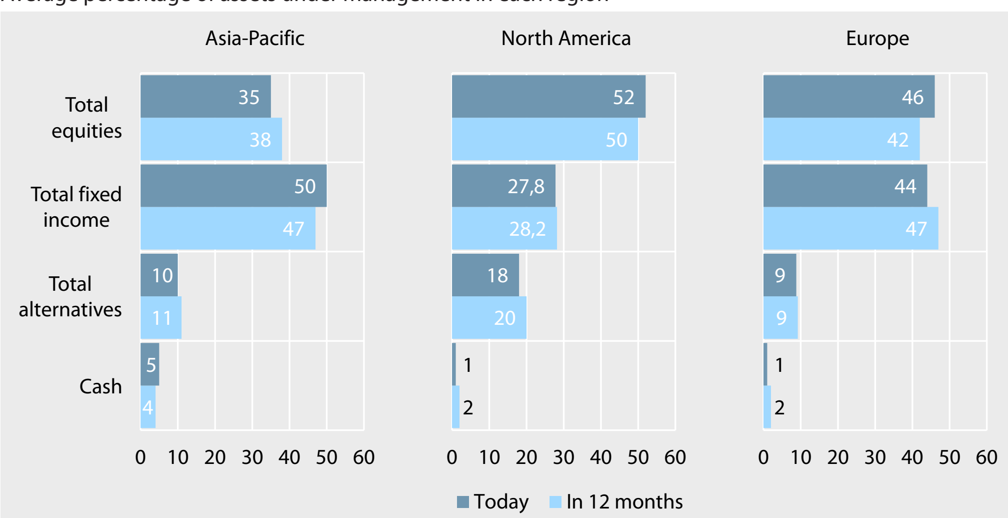
Institutional investors look for scale and flexibility

Institutional investors, in this book, refer to organizations such as pension funds, insurance companies, private wealth managers, sovereign wealth funds and large family investment offices. These institutions control and manage tremendous financial assets for various purposes, including meeting fiduciary duties, providing protection from losses, and generating financial returns, depending on the individual investor's mandate.

Unfortunately, most of the capital committed by institutional investors today has little impact in the real economy

To provide an idea of sheer scale, in 2014 pension funds in OECD countries alone managed investment assets in the total amount of USD 25 trillion. In comparison, the GDP of the EU economies in 2014 added up to only USD 18.5 trillion[1]. Insurance companies add another mind-boggling USD 13 trillion to the global assets under management.

Figure 1.1
Asset allocation distribution of institutional investors
Average percentage of assets under management in each region



Source: IICRG and AMP Capital (2014)[2].

Unfortunately, most of the capital committed by institutional investors today has little impact in the real economy. Investments are made within the confines of the financial markets – the financial economy – via indirect instruments, such as stocks and derivatives, that do not allow the underlying companies in the real economy to draw on the investments as a financial resource for growth.

Particularly private debt and equity are a relative rarity in the investment strategy portfolios of institutional investors

In contrast, more direct investment strategies, such as investments into private equity funds or corporate bonds that mediate the investments into companies, do have an impact on the real economy. However, particularly private debt and equity are a relative rarity in the investment strategy portfolios of institutional investors. As a result, small and medium -sized companies (SMEs), for instance – which provide 67% of the total number of jobs in the EU and create 71% of new jobs[3] – have only very limited access to institutional investment capital as a resource for renewal.

This investment gap is exactly where we see vast opportunities for game-changing innovations in the design of financial instruments. Just imagine the economic impact of an investment vehicle that would allow leveraging the capital commitments of large institutional investors in the real economy for the renewal of incumbent industries and the growth of emerging ones. At the onset of the work that led to this book, we set ourselves an aspirational objective: the development of just such an investment vehicle.

You might ask why institutional investors have limited interest in the real economy. If venture capitalists, banks and business angels have been able to spot and exploit the opportunities, why haven't institutional investors acted on them?

Investing into the real economy has simply been too inefficient on the required scale

The answer is at least twofold. First, investing into the real economy – one company or even a portfolio of private companies at a time – has simply been too inefficient on the required scale. Given the vast assets under management and the considerable transaction costs related to the execution of an investment transaction, the minimum ticket size – i.e. the minimum amount of capital invested at any one time by an investor – ranges between USD 50 million and USD 500 million. That is a lot more than a single portfolio, much less a single company, can absorb at a time. Indirect instruments such as stocks are much easier to bundle into large enough portfolios because their markets are highly developed. Information on stocks and derivatives is transparent and available, and the purchase and sales transactions are highly efficient – no matter the volume – thanks to advances in information and communication technology.

As to the second reason, direct investments into private companies are a lot more illiquid than indirect investments. It takes longer for private investments to generate returns because they are a function of the rise in value of the company, or servicing of its debt obligations. The value, in turn, only rises with the growth and progress of the business of the invested company. Therefore, capital committed via direct investments needs to be patient and wait for the rise in company value before returns can be expected. However, institutional investors want to maintain their flexibility and be able to redirect capital at will. Since the invested capital can't be traded or withdrawn, investors demand an additional liquidity premium on their investments, if they are to invest in the first place.

Our solution will involve combining a large enough pool of liquid and illiquid financial instruments in a single vehicle

That all being said, it is clear that if we want to create an investment fund vehicle that leverages institutional investment capital for direct impact in the real economy, we have to be able to address these inefficiencies. Solving the issue will be the first of a number of financial innovations necessary to make our vision real. Hence, our solution will involve combining a large enough pool of liquid and illiquid financial instruments in a single vehicle so that they provide both for economic impact, as well as sufficient scale and flexibility to institutional investors.

Conventional industry boundaries give way to cross-industrial, thematic growth

Impact is strongly correlated to *thematic* growth sectors of the economy. To see the connection between the two concepts, we first need to establish how modern industries evolve and grow.

As you will learn in the subsequent chapters, modern growth sectors of the economy are characterized by newly evolving collaborative relationships *across* conventional industry boundaries. For instance, take Smart Grids, a supply- and demand-side innovation to optimize energy delivery and consumption. To integrate predictive, autonomous, and user-guided intelligence into the production and distribution of energy, energy utilities and grid operators are now actively liaising with industry sectors they previously had no dealings with. These include – but are not restricted to – telecommunications operators, data analytics companies, smart meter manufacturers, system software providers and mobile application developers.

Growth sectors of the economy can no longer be properly characterized using conventional industry classifications

It has become clear that many growth sectors of the economy can no longer be properly characterized using conventional industry classifications. On the contrary, never before have such a large number of previously unrelated and diverse industry sectors joined forces to create entirely new types of value-added. Never before have value chains and value networks been this complex and diverse.

Modern industry ecosystems can best be described by their common thematic activity

If not a certain industry classification, what then is the common denominator for a given emerging ecosystem? To put it simply, it is the defining activity of the ecosystem in and by itself; an activity that shares a common *theme* such as Smart Grids, Smart Mobility or Green Chemistry. When we refer to *thematic* industries we refer to just these kinds of modern industry ecosystems: they are characterized by cross-industrial value chains and can best be described by their common *thematic* activity.

Given that thematic ecosystems are the current growth centers of the economy, an investment vehicle that allows for aligning institutional capital commitments with the emerging structures of new industries constitutes a major financial innovation with unprecedented economic impact potential.

Many existing investment strategies, by design, are incapable of driving major economic growth

Indeed, many existing investment strategies, *by design*, are incapable of driving major economic growth. In the name of risk management, most investment strategies prefer to diversify portfolios across a broad palette of unrelated industries, protecting investments from losses in any single sector. For an investor interested only in maximizing monetary returns this is a viable strategy, of course. There is no need to take into account whether the investments help to build out the economy.

For someone interested in promoting economic growth – say, the world's 80 largest pension funds (P80[4]) that have committed 3% of their assets under management (AUM) to promoting green economic growth through infrastructure or project finance – it is awfully ineffective. Thematically agnostic investment strategies spread capital commitments too thinly across various ecosystems to have focused impact on economic development.

Our objective is to develop an investment vehicle that grounds its investment thesis in sourcing deals from thematic industry ecosystems

Therefore, it is our objective to develop an investment vehicle that grounds its *investment thesis* in sourcing investment deals from identified *thematic* industry ecosystems.

How do we intend to deal with risk? Doesn't the focus on thematic ecosystems introduce systematic – correlated, or non-diversified – risks that are difficult to offset? The answer is: no. Thematic ecosystems are a collaborative network of companies from a great number of different industries. For most of these companies, their activities in any single thematic ecosystem comprise only a fraction of their other existing or potential markets. One could consider each ecosystem the companies are active within a separate market or line of business. Many of the companies – such as telecommunications operators and application software developers – are active in a number of different ecosystems. Systemic market risks will not impact each industry in the same way. In investment parlance, there is low correlation or a high degree of diversification across the portfolio of companies included in a thematic fund. Hence, the cross-industrial nature of thematic ecosystems provides for an implicit risk diversification strategy.

The multi-asset fund structure matches the right asset classes with the right companies

Identifying and understanding the industrial structure of thematic ecosystems is insufficient to execute a thematic investment strategy, and allocate investment capital to specific companies. Especially more direct investments in private companies – such as unsecured risk debt and private equity – necessitate assessing the ecosystems on the company-level. We need to understand the risk of the underlying assets.

The challenge here is the vast diversity of companies. As we described earlier, thematic ecosystems are cross-sectoral, providing for a great variety of businesses in the different industrial spaces of the ecosystem. Not only do companies vary in their industrial backgrounds, they also differ in size, stage of life-cycle, business and revenue models, capital intensity and many other characteristics that investors deem important when assessing a company.

The investment vehicle needs to provide tailored financial solutions to each individual company type

These characteristics determine the financial needs of a company and its fit with the various investment instruments that exist on financial markets. A young, pre-revenue startup cannot expect to be able to secure a bank loan to fuel its growth because there is no cash flow to cover the fixed installments of the loan. Likewise, most large enterprises are not able – nor willing – to attract private equity investments because its growth and the scalability of business are not on par with the investors' expectations.

Consequently, to effectively promote the growth and renewal of an entire thematic ecosystem, the respective investment vehicle would need to provide tailored financial solutions to each individual company type; be it a startup, small and medium -sized enterprise (SME), or a large corporate entity. It would need to combine the respective types of capital – or *asset classes* – within a single, thematic fund. The development of such a fund was the objective of our development work:

The Multi-Asset Renewal Fund

The timing is right…

…because institutional investors – frustrated with the dwindling performance of traditional investment models – are on the lookout for financial innovations to meet fiduciary duties and enhance returns; economic developers around the world are in dire need of efficient means to turn around lackluster economies and to promote industrial renewal; and, finally, growth companies – having been denied access to traditional bank risk loans in the wake of the latest financial crisis – are searching for alternative financing sources to fuel their businesses in promising new industrial ecosystems.

The impetus for developing the Multi-Asset Renewal Fund – or MARF – was given by the combined momentum of several megatrends that threaten the growth of economies and the welfare of societies.

Institutional investors are in need of higher yielding investment opportunities at moderate risk increases

Let's start with the plight of institutional investors themselves. Pension funds, in particular, are facing dire times as their cash-in – cash-out ratios are shrinking below parity. The reasons are manifold:

1. Exceptionally disadvantageous developments in the demographics of developed countries that have seen the populous baby-boomer generation transition into retirement;
2. The onslaught of digitalization plowing holes into the ranks of employees in previously labor-intensive professions; and
3. The generally very challenging conditions on the capital markets – such as the permanently low interest rates and high volatility – in the post-2008-crisis era.

Pension funds are teetering at the critical breakeven point at which fiduciary payout commitments are starting to exceed the value of available investment opportunities. As the former head of sustainable investing at one of Scandinavia's biggest banks bluntly put it: "The investment model of pension funds is broken."[5]

The investment model of pension funds is broken

Feeling threatened by the developments, many of the institutional investors that along the way helped us in designing the MARF have cautiously explored new ways to steer their investment strategies back onto a sustainable track. While conventional strategies such as stocks still remain the mainstay of institutional investing, the share of *alternative* *assets* – including private equity funds, real estate and *hedge funds* – has increased in the institutional investment portfolios (see Fig. 1.2)[6].

In response, the financial markets have reacted in the last few years by developing new financial innovations to meet the need. An entire sub-industry of financial innovators and their digital platform solutions has emerged, going now by the trendy collective label of Financial Technology, or FinTech. Crowdfunding and peer-to-peer lending are just two examples of emerging FinTech innovations.

"By 2020, alternatives could account for about 40% of revenues in the global asset-management industry"

– McKinsey

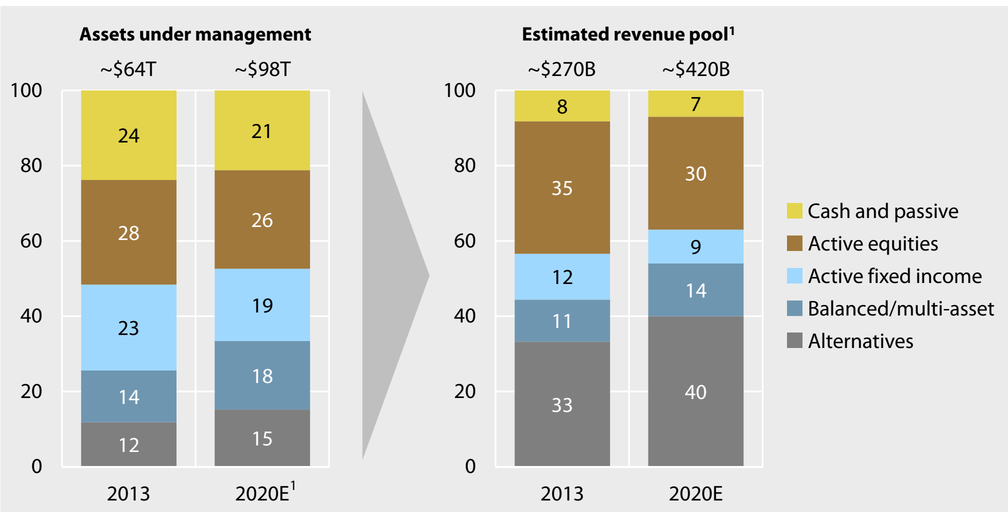
The MARF is born out of the very same opportunity. To be an effective remedy for the plight of institutional investors, one of the most critical objectives in designing the MARF was to develop a fund-internal *asset allocation strategy* – i.e., the right balance between the included asset classes – that would hold a viable promise of *sustainable returns* without exceeding the ac-

Definition: Hedge funds

"Hedge funds are alternative investments using pooled funds that may use a number of different strategies in order to earn active return, or alpha, for their investors. Hedge funds may be aggressively managed or make use of derivatives and leverage in both domestic and international markets with the goal of generating high returns (either in an absolute sense or over a specified market benchmark). Because hedge funds may have low correlations with a traditional portfolio of stocks and bonds, allocating an ex-posure to hedge funds can be a good diversifier."

Source: Investopedia.

Figure 2.2
Global asset management market (externally managed assets), %



[1] Excludes performance fees (i.e., carried interest).
Source: McKinsey Global Asset Management Growth Cube.

ceptable boundaries for the associated risks. The more detailed discussions on the risk-return profile of the MARF and risk management strategies are included in the appropriate chapters.

Economic developers feel pressure to find effective tools for re-kindling the economy

The MARF addresses the needs of yet another group of practitioners on the lookout for hands-on tools: economic developers around the world are desperate to turn around lackluster economies hit by the latest global economic crisis.

Economic developers around the world are desperate to turn around lackluster economies

Take Finland, for instance. Frequently placed at the very top of WEF's list of most competitive business environments, the country has now seen its GDP sink for three consecutive years. The economists talk about a structural problem as the engineering-driven, investment goods-heavy export industry has failed to transition into the scalable, digital economy. Stuck with industries slowly becoming obsolete, the country's industry structure is in dire need of renewal.

Other economies face similar problems for their own reasons. In Germany the *Energiewende* – the strategic commitment to let go of nuclear power altogether in the next few years – will entail massive renewal efforts as the energy infrastructure needs to be upgraded for compatibility with alternative and multi-directional energy production and transmission technologies.

China, in turn, is feeling massive growing pains as the blindingly fast economic growth of yesteryears has created an ever-growing, affluent middle class that has raised average salaries on the Chinese East coast at a speed of up to 20% annually. China has lost its competitive edge as the world's inexpensive manufacturer, and has to look for for economic renewal strategies as it is now forced to enter the very same ring with its developed Western competitors.

MARFs will directly fuel the growth of companies in the real economy and promote the emergence of entire ecosystems

How can the MARF then help economic developers in their efforts to renew industries? After all, economic developers will not have much of a say in how MARF's will be executed; the instrument is meant to be fully market-driven and privately managed. Where is the connection between financial asset management and economic development?

The instrument will *implicitly* serve the interests of economic developers. To be more precise, MARFs help to leverage private institutional funds – a previously mostly untapped resource in economic development – for the growth of the *real economy*. Many of the asset classes in MARFs will more or less directly fuel the growth of existing companies. As we will show later on, the bulk of companies that receive direct investments via MARFs are SMEs; companies that according to central statistics are the engine of economic growth.

The *thematic investment strategy* of MARFs will further enhance the instrument's effectiveness as an economic development tool because it focuses the injection of resources on identified growth sectors of the economy. Thematic MARFs promote the emergence of entire ecosystems, of long-term economic structures with lasting value creation potential.

Companies looking to reposition themselves into emerging ecosystems are plagued by growth funding shortage

The fallout of the 2008 financial crisis transcended the boundaries of the financial world in many unpredicted ways. Almost a decade later, many of the effects it had on the real economy have long been old news. Thanks to tightened regulations that aimed at reinforcing the balance sheets of financial institutions, banks have clamped down on lending to businesses. Surprisingly, if surveys by the European Central Bank are to be trusted, the share of approved loan applications has not dropped significantly[7]. A quick round of interviews on the ground, however, exposes a fairly disconcerting phenomenon behind the veil of ECB's statistics:

While companies applying for low-risk operational loans – say, to manage cash flows and receivables – have little difficulties obtaining credit from banks, agile companies looking to conquer new markets or reposition themselves into new, emerging ecosystems are much worse off.

"If you listen to the Prime Minister, or the Chancellor, or the Chief Secretary to the Treasury, they say the one thing that will bring back the economic recovery more quickly is if banks lend to SMEs – and they're not."

– Ronel Lehmann, Chief executive, Lehmann Communications @ UK Treasury Select Committee, May 2014

To provide a quick example, a Finnish jet propulsion developer discovered an opportunity to utilize their naval jet propulsion technology in combating floods in the Far East. To do so, the company planned to send a small number of their engineers onsite to investigate both the market potential and technical specifications of a potential solution for a few months. Unfortunately, despite steady cash flows from the company's existing lines of business, banks were either unable or reluctant to finance the endeavor; mostly, because there was no tangible collateral specific to the purpose the loan was sought for. Providing an unsecured loan would have looked bad in light of the tightened regulations.

If the anecdote were in any way representative of a funding plight experienced by growth companies, the worst of consequences of the recent financial crisis is still to be faced: the incapacitation of economies to renew themselves fast enough. To cut off SMEs from the funding source they have relied on for so long is to deprive them of their ability to experiment, explore and expand; the one ability that makes them so indispensable for industrial change and new job creation.

"A bank doesn't want to be sitting on illiquid assets for a long time, but shadow banks [e.g. pension funds] have a higher capacity to take illiquid assets and sit on them for a very long time"

– Alan Capper, Lloyds

With the MARF, it was our objective to develop an alternative funding source for growth SMEs. If banks are unable to serve the role due to ever stricter regulations, the MARF is an efficient solution for providing SMEs with an almost direct access to the financial resources of large institutional investors. The same investors, with conventional instruments, were previously unable to efficiently commit capital to growing economies.

It is challenging to achieve…

…because the institutional investment domain views innovative investment instruments with risk-averse skepticism; the regulatory thicket governing financial markets is hard to navigate for new investment vehicles; the identification and validation of emerging industrial ecosystems with true economic growth potential is a complex undertaking; and, finally, the management of a multi-asset investment fund structure requires both a very broad and in-depth professional skillset few finance professionals are endowed with.

The implementation of financial innovations lends itself to a comparison with running the proverbial gauntlet. When risk and return are at stake, particularly where pension funds are involved, any new financial instrument has to pass actuarial muster. The MARF is not exempt in any way.

Institutional investors are highly sceptical of new investment vehicles

To start with, institutional investors – those mandated with fiduciary duties, in particular – are highly sceptic with regard to new investment vehicles. And they have good reasons to be so. For instance, the pension fund model is based on very stable, albeit relatively moderate returns, and is therefore vulnerable to high volatility. The model favors long-term commitments of capital to steadily yielding assets. In periods of particularly low returns – such as the current, low interest rate environment – volatility impacts can be dire. Any new investment vehicle candidate needs to pass a test of market validation and actuarial risk and return requirements.

Winning over potential asset managers is one challenge, navigating the post-2008-crisis thicket of regulations that govern financial markets is another. Luckily the European Central Bank, the European Union and various governments have woken to funding the plight of growth companies and have started to create tailored and transparent rules for funding instruments alternative to bank lending. These instruments include the bundling of small business loans into asset-backed securities (ABS), and long-term investment funds[8] (LTIF). Both are geared towards enabling large institutional investors to effectively commit their capital while alleviating the problems caused by a drought in small business funding. The MARF will take advantage the developments and follow the trail blazed by these regulatory innovations to access financial markets.

European Central Bank President Mario Draghi is considering plans for a new model of financing aimed at making it easier for small businesses to access funding from "non-bank financial institutions" which could include pension funds and insurers."

– CNBC

Another challenge relates to the MARF's thematic investment thesis. How are emerging ecosystems with enough industrial momentum identified and selected to warrant sustainable financial returns. The biggest challenge in thematic investing is in choosing a theme that is not a political fad, but rather is grounded in economic reality. Investment strategies indeed need to be aligned with and designed by leveraging verifiable growth signals from the economy. Investments only yield returns if the underlying companies grow and prosper.

Investment strategies indeed need to be aligned with verifiable growth signals from the economy

Political vision is a necessary but insufficient prerequisite for selection of an investable theme. As we will show in later chapters, the MARF uses quantitative data on existing business relationships between companies to establish whether any given thematic ecosystem truly exhibits industrial momentum. This in and by itself is a novel approach to portfolio design.

Finally, managing a MARF calls for an exceptionally broad skillset that few finance professionals in the industry have. The challenge in the management model is that up to four different asset classes have to be balanced in a single portfolio. Asset managers with a multi-asset background are a true rarity. Why? Conventional finance theory assumes that markets are efficient enough to coordinate investments of any single investor into separate assets. Consequently, asset managers have largely specialized in managing individual asset classes. There are those specialized in exchange traded funds (ETF), those managing futures and other derivatives, managers in charge of bond portfolios, risk-loving venture capitalists and so forth.

What a MARF requires, however, is someone who knows how to deal with a blended mix of different asset classes. Fortunately, with the amount of novel financial innovations on the rise – including hybrid instruments such as the debt-equity vehicle managed by the Finnish boutique asset management company Juuri Partners – the number of suitable managers with multi-asset capabilities will grow as well.

A MARF requires someone who knows how to deal with a blended mix of different asset classes

By working with…

…asset managers, institutional investors, economic development agencies and other potential practitioners and adopters, we will make this vision real by developing a process for (i) identifying promising new industrial ecosystems, (ii) assessing the respective companies for their investment grade, (iii) designing the structure and investment thesis for a Multi-Asset Renewal Fund (MARF), and (iv) establishing the fund's investment rating to promote its adoption in the financial markets.

We have laid out *what* we seek to develop in the MARFs, *why* we think the moment is opportune to do so, and *which* shoals MARFs need to be navigated around before market rollout. What is still missing from the story is its thread, an exploration of the question *how*. This is what the bulk of this book is intended to be about. Let's summarize the three key phases in the design process of a MARF.

First, we need a systemic and data-driven methodology to identify and verify the materiality of emerging industrial ecosystems. As discussed, the methodology needs to distinguish economic momentum from policy fad. Returns can only be expected from growth in the real economy, and therefore we need to make sure that the identified ecosystems are grounded in macro-economic principles. The structure of an emerging industry ecosystem is uncovered by way of financial network maps.

The mapping approach and interpretation are detailed in Chapter 3.

Once the structure of an ecosystem has been confirmed, it is time to separate the companies in terms of their investment grade. Hence, companies need to pass a rigorous due diligence to be considered for inclusion in the MARFs. Our due diligence process has two phases. In phase one, companies are assessed on their value capture capability. We ask how much of the value a company generates is actually retained – or captured – and how much of it is appropriated by its partners. The intuition is simple: stronger value capture capabilities allow companies to exploit a larger share of

Companies need to pass a rigorous due diligence to be considered for inclusion in the MARFs their upside potential. Given their value capture potential, the second phase of the process then assesses their investment grade. This analysis determines the type of capital suitable to a company's business model, market proliferation, capital intensity and other factors that determine the speed at which a company can exploit its full potential.

Company assessments are the subject of Chapter 4.

Once a sufficiently large pool of investee candidates has been identified, it is time to structure the actual MARF itself. In Chapter 5, we show how financial metrics and statistical methods are employed to determine an optimal, fund-internal asset allocation strategy given the results of the investment grade analysis. The key asset classes of the MARF include unsecured risk -debt, private equity, exchange traded funds, and thematic corporate bonds.

In Chapter 6 we will discuss the fund's management model, and other distinct features that characterize the MARF as a unique instrument. These include the employment of governmental guarantee instruments for de-risking the riskiest asset classes in the fund, for instance.

Finally, to complete the process, in Chapter 7 we establish the MARF's investment rating, by adapting accepted rating methodologies from rating agencies.

The design process will be applied to real world cases. Given the recent comeback of Cleantech and sustainability onto the agenda of global investors, we test our concepts on three separate ecosystems in the greening spaces of economies: Smart Grid, Smart Mobility, and Green Chemistry. These pilots have generated useful insights with regard to the ecosystems' various strengths and weaknesses. Therefore, besides offering a thorough treatment of the MARF's design process, the book provides abundant policy insights and managerial implications to the ambitious business director and the concerned economic developer vested in drawing strategic roadmaps. The application of the MARF concepts on the three Cleantech ecosystems is detailed in Chapter 2.

With that, we hope to have piqued your interest and wish you an enjoyable time exploring the content of this book.

References

1 World Bank: http://data.worldbank.org/region/EUU

2 Institutional Investor Custom Research Group and AMP Capital (2014): Asset allocation shifts at pension and retirement plans. AMP Capital, Insti-tutional Investor Report 2014/4

3 Eurofound (2016). ERM annual report 2015: Job creation in SMEs, Publications Office of the European Union, Luxembourg.

4 http://www.globalsolutionssummit.com/p-80-group-foundation.html P80's mission statement: "Our mission is to lead and guide the world toward a path of greater sustainability by developing financial instruments that deploy capital into technology that tackle global challenges."

5 Antti Savilaakso, Nordea, Corporate Venture Day 2014.

6 McKinsey (2014). The Trillion-Dollar Convergence: Capturing the Next Wave of Growth in Alternative Investments. Financial Services Practice, AUG 2014.

7 European Central Bank (2015). The euro area bank lending survey Second quarter of 2015. ECB, Frankfurt, Germany.

8 http://www.consilium.europa.eu/en/press/press-releases/2015/04/20-long-term-investment-funds/

2

Setting

Nordic Cleantech – An Ideal Testbed for Financial Technology

Nordic Cleantech – An Ideal Testbed for Financial Technology

> *Green technologies – going green – is bigger than the Internet. It could be the biggest economic opportunity of the 21st century.*
>
> – John Doerr, Venture Capitalist

In the introduction, we promised to keep the real-world application of the Multi-Asset Renewal Fund (MARF) design process close to hand at all times throughout the book. Indeed, novel concepts are easier to absorb when observed in action. Thus, before commencing the deep-dive into the development of MARFs in the sub-sequent chapters, we introduce you to our real-world setting – the Finnish Cleantech space.

For those who wonder why we elected the remote Nordics as the testbed for MARFs, let us briefly illuminate a few reasons behind the choice. Those who are eager to plunge right into the thick and thin of MARFs are most welcome to take a shortcut and jump over to the next chapter.

In 2014 Finland was among the top-3 Cleantech economies in the world

The latter be warned, though! You will miss highly interesting insights into a returning industrial trend that will sooner or later inevitably sweep across economies all around the globe. According to recent WWF & the Cleantech Group[1], in 2014 Finland was among the top-3 Cleantech economies in the world; it is only a matter of time when the issue becomes serious business in countries that for now still lag behind.

So, why the Nordics? The first and most central of reasons is unhindered access to data. The Nordic countries are known for very transparent business reporting standards and regulations. Unlike in most other regions of the world, in Finland even private companies – no matter how young or small – submit financial statements on the same level of detail as publicly traded companies to freely and publicly available databases. Unlimited access to financial data, in turn, is crucial to our endeavors as we need to empirically test and simulate the financial performance of MARFs.

A second reason to head north is just as practical. As we will shortly elaborate on further, the country's ailing economy is at a crossroads.

Economists in Europe have long spoken of a need for the country's structural renewal as its conventional industry space has lost its momentum. Nokia's recent demise in the mobile communications industry is probably the best-known case in point. And restructuring is precisely what best characterizes Finland's current state of matters. The country's strong history in telecommunications, information technology and electronics gives it a formidable pool of resources and skills that are only waiting for an opportunity to be employed in new economic growth sectors. The setting serves our purposes well: Finland is a growth bed for new industrial activity and emerging ecosystems; the perfect environment to identify thematic growth spaces and to test our investment vehicle on.

Finland is a growth bed for new industrial activity and emerging ecosystems

Without further ado, here is the Finnish Cleantech space.

From policy fad to respectable economic activity

In the past decade, Cleantech seems to have graduated from a glorified, policy-driven fad and the scourge of over-zealous venture capitalists to a perceptible, economic megatrend with considerable industrial and financial momentum.

Only as recently as 2008 did the Economist[2] proclaim the "downturn of clean technology" under the "gathering clouds" of the global economic slowdown. Today, Chrysalix EVC[3], one of the longest standing venture capital firms in the Cleantech space, estimates that the total addressable market in Cleantech will grow to a size anywhere between three and four trillion USD by 2020; an eight-fold increase since 2005. In 2013, global investments into green energy alone exceeded $200Bn, a figure that is expected to triple until 2030[4]. To put the numbers into perspective, current investments into fossil-fuel-based power generation top out at $270Bn.

The market performance of select vanguard names in Cleantech provides further support for the sector's long-awaited success story that many are still rather cautious to buy into. According to CapitalIQ and Bloomberg, the present-market-capitalization-over-IPO-value multipliers of companies such as Cree, Tesla and Solar City are on par with those of ebay, Google, Linkedin and Facebook. Certainly, one cannot ignore the growing body of economic and financial evidence speaking in favor of Case Cleantech. Nonetheless, the agnostic will still want to know what is driving this surge in Cleantech. What are the incentives? Where are the growth opportunities? How have business models shifted? Why is Cleantech back on the agenda?

Threats are effective drivers for the greening of economies

As an incentive, the stick is often mightier than the carrot, they say. In the context of Cleantech, the stick comes in the form of increasing resource scarcity and global warming (WEF[5], PWC[6], KPMG[7]). Already, decision makers in business and politics alike are starting to feel the pain brought on by the foreseeable negative impacts of environmental and social sustainability trends, if neglected:

1 Rapid growth in the planet's population and the gentrification of developing economies exacerbates the competition for resources as pressures to increase the production of food, energy and minerals rise. According to the UN, the demand for food will increase by 30 percent until 2030; and by a staggering 50 percent until 2050. In parallel, crop yield in agriculture grows at an ever slowing rate of only 1 percent annually. Four decades ago the rate still was twice as high. With demand outpacing production, prices are bound to soar and weaken the purchasing power of consumers.

2 In the wakes of Fukushima's nuclear tragedy and Ukraine's political conflict, businesses and governments are redirecting emphasis on energy security. Strategies in the energy space focus on diversifying risk by increasing the number of producers and suppliers as well as by accelerating the integration of renewables in the energy mix. The uncertainties in this space are reflected in increasing energy prices that, depending on the sector, already make out 5–20 percent of businesses' total costs.

3 According to the newest findings by the International Energy Agency (IEA), the cost impact of global warming will exceed 3.2 percent of global GDP by 2030, if attempts at curbing emissions-related increases in the global temperature should fail. Current estimates value present costs at $1200Bn (DARA, 2010[8]). To de-risk potential consequences of climate change on society and the economy, governments are setting in place regulatory measures that drive sustainable production and consumption. These regulations set new strategic and operative boundaries for businesses, challenge incumbent business models, and provide ample opportunities for new, innovative businesses and incumbents that seek to renew their business practices. Even behemoths such as Exxonmobile, Microsoft and General Electric already forge strategies that are compatible with business environments subject to carbon tax – like regulatory innovations (New York Times, 2013[9]).

4 Regulatory schemes – the governmental armory of sticks – are complemented by more direct measures such as the withdrawal of current subsidies. The International Institute for Sustainable Development (IISD) estimates that governments around the world subsidize the production and use of fossil fuels with a compound $600Bn annually. About $100Bn thereof are said to go to the oil producers directly. As outlined by the Global Subsidies Initiative in 2010[10], decision makers at the G-20 Pittsburgh Summit proclaimed that "inefficient fossil-fuel subsidies encourage wasteful consumption, distort markets, impede investment in clean energy sources and undermine efforts to deal with climate change." The Summit's yield was a joint decision to phase out inefficient fossil-fuel subsidies that encourage dissipative consumption. When and how a phase-out will hit producers, investors, industry, business and other central stakeholders such as consumers is not known, but the impact will be felt widely with great certainty.

"Inefficient fossil-fuel subsidies encourage wasteful consumption, distort markets, impede investment in clean energy sources and undermine efforts to deal with climate change."

– Global Subsidies Initiative

5 In many countries, governments and NGOs take on more aggressive roles in the promotion of Cleantech related sectors. In Finland, for instance, the Ministry for Employment and the Economy has launched a "Government Strategy to Promote Cleantech Business in Finland"[11]. By 2020 the strategy aims (i) to raise the compound turnover of Finnish Cleantech companies to €50Bn, of which exports would account for over 75%, (ii) to double the Finnish Cleantech home market to about €20Bn, (iii) to raise the number of Cleantech companies from 2000 to about 3000, and (iv) to create at least 40,000 jobs in clean technology in Finland. To name a few action points of the strategy, the "Ministry of Finance is to annually provide €30M in investment subsidies for Cleantech demonstration and reference projects, which are to catalyze €150M in investments into Finland." Prize money for companies winning in international Cleantech -related business plan competitions is set to €1M. Furthermore, the "Ministry for Foreign Affairs is to name shared Cleantech envoys to more than 100 countries by 2015." In the NGO space, the Global Cleantech Cluster Association (GCCA), a meta-cluster with the vision "to drive sustainable regional economic development on a global scale", has grown in only four years of its existence to encompass 50 clusters from across the world, representing 10,000 Cleantech companies. The GCCA is collaborating with the P80 Group Foundation and Club de Madrid to support the Global Technology Deployment Initiative.

6 In parallel with the corporations and governments, the financial markets are bracing for the impact that regulations and changes in consumption will have on the valuation of companies that produce and refine fossil fuels[12]. The rise of ESG (Environmental-Social-Governance) -indexed funds, impact investing, and responsible investing reflect growing concerns about a shift in the valuation of business models and practices. Pension funds that are by far the largest investors in fossils-based businesses are especially exposed to carbon risk, because of the annual dividends paid out by oil and gas companies. The question is when do pension funds start repositioning their vast resources towards a green (or better, carbon-free) economy? And where are those funds to be placed? A recent Environmental Finance workshop in London indicated that part of the problem is the dearth of green assets for allocation. The challenge is, pension funds do not like thematic investments. To them themes are policy-driven fads subject to political volatility[13].

In summary, commitment to and opportunities in Cleantech seem to finally materialize in tangible form. Hype is being replaced by a growing concern about the sustainability of not only the environment but that of societies. Food, housing and transportation costs are on the rise as resource scarcity is becoming more imminent in a world with a fast growing population but finite assets. Fortunately, driven by this concern, governments, businesses and consumers alike seem to share a common view of the necessity to green the world's economies.

That being said, governments can do only so much. While setting the incentives, they do not produce the solutions. Consumers, on the other hand, are many times told by businesses what they need and what options they can choose from. Hence, companies play a crucial role. The question then is how well is the corporate space positioned to take advantage of Cleantech and drive change? What is the state of Cleantech as a business today? How do Cleantech companies need to restructure their business models to enable scale of adoption and profitability? And most importantly – for the development of MARFs – is the larger Cleantech space really a growth bed for new industrial ecosystems?

What is Cleantech?

To provide some empirical answers to the questions, we take a close-up look at the commercial Cleantech space in Finland. The picture is drawn using numeric, categorized distributions of central economic indicators such as turnover, number of employees, profit margin, and return on investments.

Before diving into the numbers, however, we should first agree on what it is the numbers are depicting. Given the strong sentiments different stakeholder groups have developed towards Cleantech in the past two decades, one is inclined to think that by now it is a well-defined, manifest concept.

The truth is somewhat disappointing. Anyone randomly searching for a definition among literature or online sources soon finds that it is everything but well-defined. Existing definitions are extremely vague and ambiguous. They are either too narrow or describe technological, industrial and strategic spaces so vast they lose all functionality as a definition. For the reader's convenience, a small sample of existing definitions for Cleantech is given below:

1. "Clean technology (Cleantech) is the installation or a part of an installation that has been adapted in order to generate less or no pollution. In clean as opposed to end-of-pipe technology, the environmental equipment is integrated into the production process." – *OECD/UN14*.

2. "Cleantech refers to products, services and processes, which promote the sustainable use of natural resources while reducing emissions. Cleantech is not an industrial sector of its own but the markets for the products and services are found in all industrial sectors, especially from technology, energy and construction sectors." – *Ministry for Employment and the Economy, Finland*.

3. "In brief, Cleantech refers to technology, products and services which generate superior commercial benefits to customers while addressing significant environmental concerns such as global warming, sustainability of natural resources and energy security." – *ecoConnect, UK*

4. "A broad base of processes, practices and tools, in any industry that supports a sustainable business approach, including but not limited to: pollution control, resource reduction and management, end of life strategy, waste reduction, energy efficiency, carbon mitigation and profitability." – *Clean Technology Trade Alliance*

5. "Cleantech, also referred to as clean technology, and often used interchangeably with the term greentech, has emerged as an umbrella term encompassing the investment asset class, technology, and business sectors which include clean energy, environmental, and sustainable or green, products and services." – *Neal Dikeman, Jane Capital Partners LLC*

6 "A shortened form of "clean technologies", a term used to describe an investment philosophy used by investors seeking to profit from environmentally friendly companies. Cleantech firms seek to increase performance, productivity and efficiency by minimizing negative effects on the environment." – *Investopedia*

7 "Cleantech is any product or service that improves operational performance, productivity, or efficiency while reducing costs, inputs, energy consumption, waste, or environmental pollution. Its origin is the increased consumer, regulatory, and industry interest in clean forms of energy generation – specifically, perhaps, the rise in awareness of global warming, climate change, and the impact on the natural environment from the burning of fossil fuels." – *Wikipedia*

Despite their ambiguity, the above definitions converge on a number of issues: First, Cleantech is not an industry in its own right. It is technologies, products, services, processes, practices and investment classes that promote the sustainable development and greening of incumbent and emerging industries as well as societies. Second, through efficiency gains or entirely novel alternatives it reduces the unsustainable exploitation of natural and societal resources in industry, business and consumption. Third, it provides industries, businesses and consumers with superior value propositions when compared to conventional solutions.

So far so good. The definitions do not contradict each other and provide three loose criteria that Cleantech should match to be recognized as such. Again, one might be inclined to think that, in the absence of more definite parameters, one would at least be able to spot a Cleantech company on sight. After all, we know that entire US Supreme Court cases have been decided based on the famous "I know it when I see it"-heuristic[15]. Before succumbing to the lures of false self-confidence, however, let us first review a few real-world examples.

Example 1: Renewable energy generation. The use of fossil fuels for energy production and transportation has been viewed as the number one driver of global warming and climate change. If using wind, solar, wave or hydro power helps to curtail the threats and costs of natural disasters, food shortage, disease, environmental degradation, loss of property and social turmoil then the average person will agree that renewable power generation indeed meets the above criteria of Cleantech. And so agree the authors. Other equally unchallenging examples can be found in the areas of waste water treatment, electric vehicles, recycling of materials and many others. This was somewhat trivial.

Example 2: Resource sharing services. Here the problem becomes more complex already. Take a car sharing service provider such as Zipcar or car-pooling service companies the likes of kyyti.net. Sharing the right to use a vehicle or offering redundant seat space to travelers headed towards the same destination can very well be argued to fulfill the three criteria:

1 the activity is clearly not a traditional industry of its own, but a service that provides information for the coordination of the efficient exploitation of *existing, redundant* assets and is built on top of existing industrial infrastructure such as telecom and IT networks, cars, etc.,

2 it generates both natural and societal resource efficiencies as it substitutes for new car manufacturing and related resource consumption up the value chain, decreases traffic congestions and pollution, and reduces overall fossil fuel consumption, and

3 it provides new value added to users in the form of (a) foregone insurance, parking and maintenance payments, (b) access to a car for low-income or low-use individuals who could not otherwise afford it, and (c) the convenience of on-demand transportation without the burdens of ownership such as the daily search for parking, which has been argued to make up a forth of the total time spent in a car in metropolitan areas.

Calling car sharing services Cleantech seems not to be too far-fetched

Apparently, calling car sharing services Cleantech seems not to be too far-fetched. But then again, transportation and its connection to Cleantech are still fairly easy to grasp for most of us; the links between their use and its detrimental impacts to the environment and (personal) economy are very direct.

What about more indirect links, then? Who, for instance, would say that Airbnb is a Cleantech company; a company that defies the hotel business by facilitating the temporary renting of private homes online? We could run the company through the three criteria and show with ease that both the environment and users gain from the use of the service. For example, according to Pure Energy Partners, a room booked via Airbnb boasts a 66% reduction in carbon emissions per night over a hotel room[16]. Many would still argue that "clean" is just a serendipitous by-product that the providers of the service have skillfully harnessed for marketing purposes. We let you decide.

Example 3: Data analytics services. Let us go even further and claim that Google is a Cleantech company. Before dismissing the notion as ridiculous consider the following: In many Cleantech sectors, especially those that are considered "smart" (e.g., Smart Grid, Smart Mobility, Smart Cities), the entire business model and technology is built on and around increasingly growing masses of user data. In Smart Grid, for instance, power utilities want to anticipate peaks in electricity consumption well in advance to avoid the very unprofitable use of emergency generation capacity. A growing installed base of smart meters in homes and industrial facilities enables utilities to tap into the power consumption patterns of their customers in real time. The hook is that utilities are not very efficient at interpreting Big Data. Patterns are challenging to identify if you do not know how and what to look for.

In many Cleantech sectors, especially those that are considered "smart", the entire business model and technology is built on and around user data

Enter data analytics companies. Specialized analytics companies such as Enernoc can provide utilities and other industries with pre-digested, customized data analyses that turn dumb and messy masses of data into smart action points. Specialized companies are in no way the only ones hungry for a sizable chunk of these fairly virgin, fast growing analytics markets. Google is one of the most aggressive contestants in the field. So is Amazon. If former search engines and online retail outlets are soon-to-be core players in Cleantech, where do you draw the line? Here comes the *cleanweb* opportunity: The emergence of new kinds of companies that take advantage of advancements in information technology.

The Finnish Cleantech industry – A *de facto* definition

The difficulties to provide an explicit definition for Cleantech are inherent in its own cross-industrial and cross-technological nature that transcends existing demarcations of traditional industries and technologies. In the case of dedicated pure-players, the task is easier but the more diverse and numerous a company's portfolio of business lines is, the harder it is to identify it as a representative of the Cleantech space.

To add to the difficulty, dedicated and specialized Cleantech companies – designated "pure players" in the book – lean heavily on an entire ecosystem of stakeholders that would not explicitly identify themselves as Cleantech organizations. Google, as a big data generalist, would probably not admit to being a Cleantech company; nor would a sub-component producer for smart meters do so. And yet, they are indispensable players in the Cleantech ecosystem due to their central roles in the value chains of pure players.

We concede that an airtight definition eliminating all room for interpretation is next to unattainable. Hence, we addressed the issue of definition by reverting to a *de facto* approach: We merged lists of Finnish Cleantech companies compiled for internal development purposes and in use by central governmental and non-governmental economic development organizations such as Cleantech Finland, Confederation of Finnish Industries, Ministry for Employment and the Economy, the Finnish Funding Agency for Innovation, Centre for Environment and Energy, and Lahti Region Development. While not necessarily a highly academic solution, it is an empirical, practice-proven approximation of the Finnish corporate Cleantech space as established by some of the most influential economic development organizations in the country. In the remainder of the chapter, we refer to the list of companies and the pool of their respective data points collected from a number of public and private databases as 'the data'.

Our final set of companies includes more than 750 Finnish Cleantech companies active in 21 different thematic industries. We are primarily interested in those companies that drive these industries in the areas of technology, business models and markets. Hence, the above number is exclusive of companies in support industries. The important supporting role of *infrastructure construction companies*, *technology-* and *business consultancies*, *financiers*, *generic component manufacturers*, *retailers* and other stakeholders must be acknowledged from an ecosystem-wide perspective, but are excluded from further analyses in this report.

Industry classification – Manufacturing companies dominate Finnish Cleantech

By now you know that the Cleantech space intrinsically defies any single industrial or technological definition. One constructive approach to bring structure to the depiction of the space is to break it down by conventional industry classifications such as the *European industrial activity classification* (NACE) used by European statistics authorities.

As Figure 2.1 reveals, the Finnish Cleantech space does not mirror the structure of the Finnish economy as a whole; it is a lot more *manufacturing*-centric. According to the data, more than a third of all Cleantech companies in Finland operate in the *manufacturing* sector. The equivalent figure for the general economy is a mere seven percent. The importance of *manufacturing* in the Cleantech space is even more dramatic when looking at the breakdown by *turnover* or *number of employees*. Over 60 percent of the *turnover* generated in the Cleantech sector is generated in *manufacturing*. Similarly, more than half of the jobs in the Cleantech space are offered by companies active in the *manufacturing* sector.

The Cleantech space intrinsically defies any single industrial or technological definition

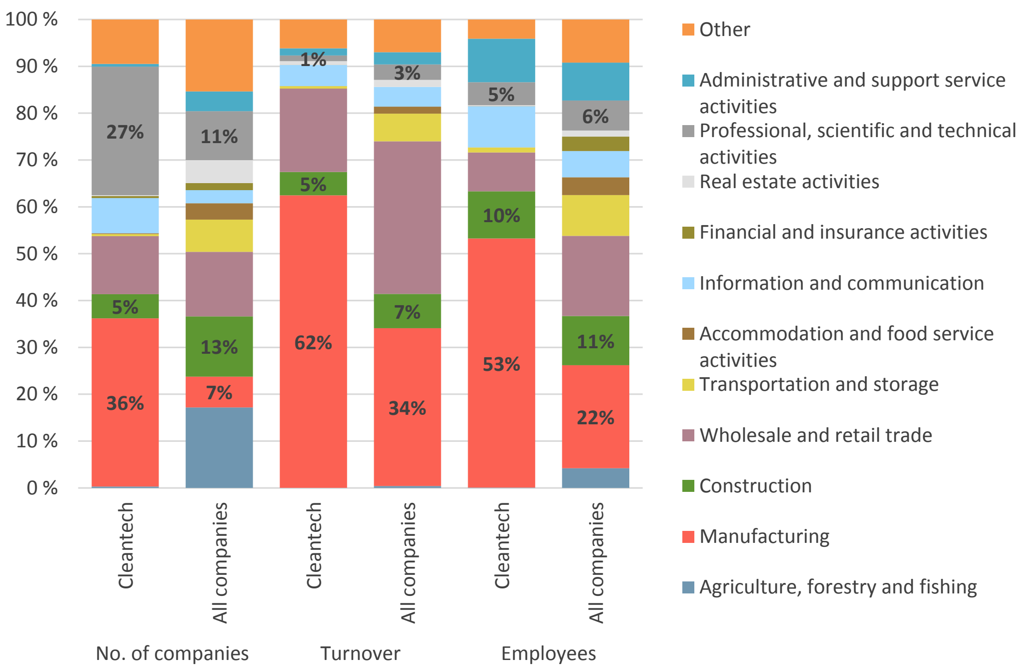
The dominance of *manufacturing* in the Cleantech space can be the result of several complementary issues:

1 The Finnish Cleantech space simply is *manufacturing* driven. A focus on the development of *physical technology* rather than *software* and *services* can result in the relative dominance of engineering companies in the population.

2 Cleantech in Finland is largely understood and defined as an engineering-related activity. Hence, the dominance of manufacturing in the population is a function of a rather narrow definition of Cleantech itself (see the definition put forth by the OECD, for instance). A manufacturing -based approach to the definition is understandable from the economic developers' perspective, given their focus on job creation.

3. The data only encompass companies that are Cleantech dedicated. By nature, software developers and service providers are more frequently generalists than manufacturing companies and, therefore, might have slipped through the filter. Hence, a relatively large share of non-manufacturing companies may have been excluded from the data.

Figure 2.1
Breakdown of data by NACE industry classification



4 On average, manufacturing companies are larger than companies in other sectors. Therefore, the importance of the manufacturing sector tends to be over-emphasized when looking at the data by volume-based indices such as turnover and number of employees.

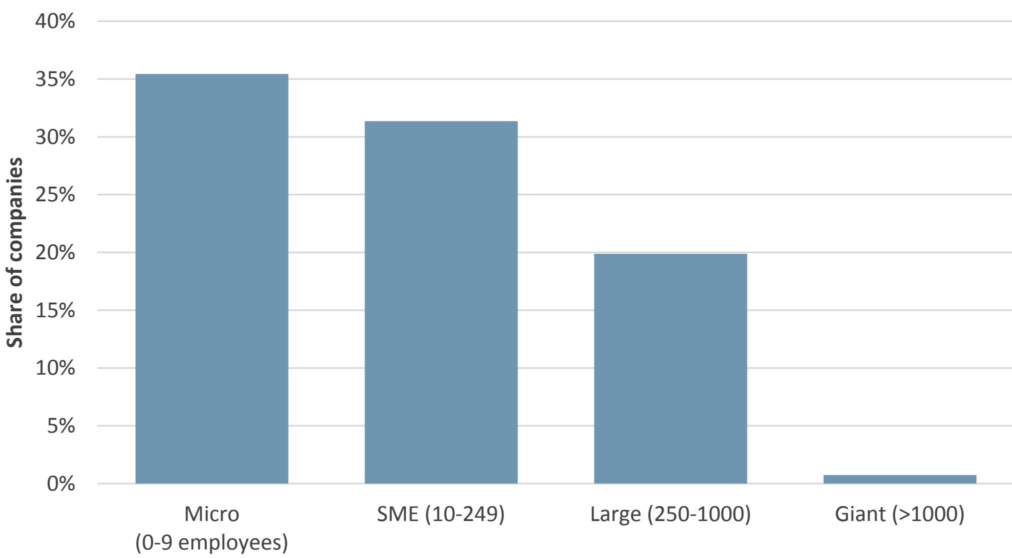
Moving on to other sectors, the share of companies in the sector pursuing *professional, scientific and technical activities* – e.g. *legal and accounting activities*, *scientific research and development*, *technical testing and analysis*, *engineering activities* or *advertising and market research* – is equally higher in the Cleantech space (27%) than in the overall economy (11%). *Turnover and employment* -based comparisons yield less drastic differences as the *average size* of Cleantech companies active in this sector is relatively small.

The *commerce* as well as *information and communication* sectors obtain shares comparable to the Finnish industry in general, while the *agriculture and forestry* as well as *construction* sectors seem to be clearly underrepresented in the Cleantech space.

Size – Finnish Cleantech companies are comparatively large

The population of Finnish Cleantech companies – as specified here – employs a total of 83,360 individuals. As Figure 2.2 shows, the majority of the companies, nearly 70%, are either *micro enterprises* or *small and medium -sized enterprises* (SMEs), employing less than 250 employees. Constituting more than a third of the population, *micro enterprises* that

Figure 2.2
Cleantech company population by size



employ less than 10 individuals are particularly frequent. *SMEs* comprise 30% of the companies, while *large enterprises* that employ more than 250 individuals make up another 20%. Companies designated *giants* occupy a separate category. The reasoning behind this somewhat unconventional classification is a very practical one: a *giant*, employing more than 1000 individuals and generating annual *revenue* in excess of 1 billion euros, can significantly distort the descriptive statistics in a small population – especially when subsections of the data are to be examined. For instance, out of the 13 000 patents held by the population of Cleantech companies, more than 9 700 are owned by Nokia. For this reason, the giants were treated as a separate sample and excluded from the analyses and averages presented hereafter.

The six largest companies account for more than 65% of the toal revenue of the Finnish Cleantech space

We identified six giants in the data, all of which operate in the manufacturing sector: Wärtsilä Oyj, Neste Oil Oyj, Nokia Oyj, UPM-Kymmene Oyj, Stora Enso Oyj and non-listed ABB Oy. These six companies account for roughly 80% of the turnover of all Cleantech companies in the *manufacturing* sector and more than 65% of the *entire* Finnish Cleantech space.

Interestingly, the proportion of *large* and *giant* companies is notably *larger* in the Cleantech space than in the Finnish industry as a whole. In 2012, Finland's total company population mainly consisted of *micro-sized* companies: more than 90% of the population were *micro enterprises*, of which more than 60% employed only one person[17]. These *one-person companies* often operate in the *services sector*, such as *education*, *personnel services*, as well as *beauty-*, *social-* and *healthcare services*. Comparatively, the 35% of Cleantech companies that employed less than 10 individuals seems a rather small share.

Thematic sectors – Renewable energy, water treatment, and biofuels largest in Finland

Traditional industry classifications do not disclose information on a company's activities in the Cleantech space, as they are agnostic to most technology-based paradigms such as *biotechnology*, *nanotechnology* or *clean technology*. To make things even more difficult, Cleantech today permeates through most of the conventional industry sectors, a phenomenon which renders the respective conventional classifications an even poorer indicator.

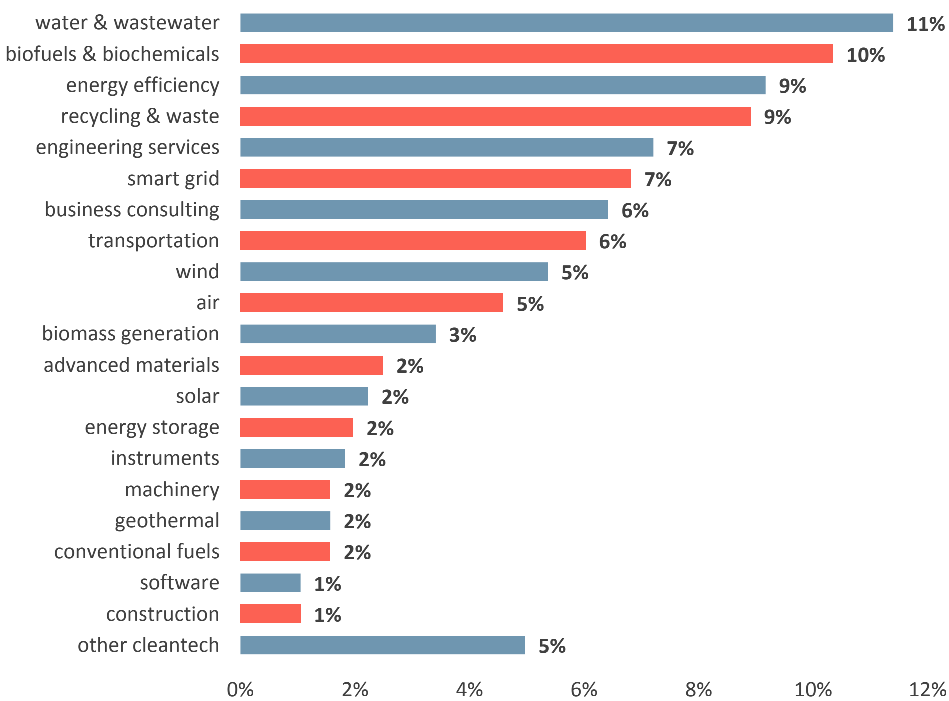
To exemplify, ask yourself how, for instance, *telecommunications providers* or local *power utilities* play the Cleantech-game? Their conventional industry classifications – *telecommunications* and *electricity supply*, respectively – do not give away much, if anything, on their specific

Cleantech activities. A *telco operator* might play an important role in a regional *Smart Grid network* or provide the *telecommunications infrastructure* for a city's *e-mobility platform*. Similarly, a *power utility* might focus on *renewable energy* sources or apply cutting-edge *demand-response technology* in its generation control to stay ahead in the race towards sustainability.

To shed light behind the veil of conventional industry classifications, the Cleantech companies were manually examined and classified into *thematic Cleantech sectors*, such as *wastewater treatment*, *advanced materials*, *biofuels*, *recycling systems* and *solar power generation*. The classification yielded 34 different Cleantech sectors or sub-domains.

The results presented in Figure 2.3 show that the sectors *water and wastewater treatment* (11%), *biofuels and bio-chemicals* (10%), *energy efficiency* (9%), as well as *recycling and waste treatment* (9%) are the most abundant in Finland.[18] It is important to highlight that *renewable energy generation* – combining *solar*, *wind*, *biomass*, *hydro* and *geothermal power generation* – would account for 12% of the Cleantech companies and therefore represent the largest single Cleantech sector. To avoid compromising the level of detail, however, we keep the sectors separate. The sector *Other Cleantech* includes sectors such as *mining*, *hydro and marine power*, *fuel cells and hydrogen*, *metals*, *electronics* and *environmental services*.

Figure 2.3
Distribution of companies by Cleantech sectors



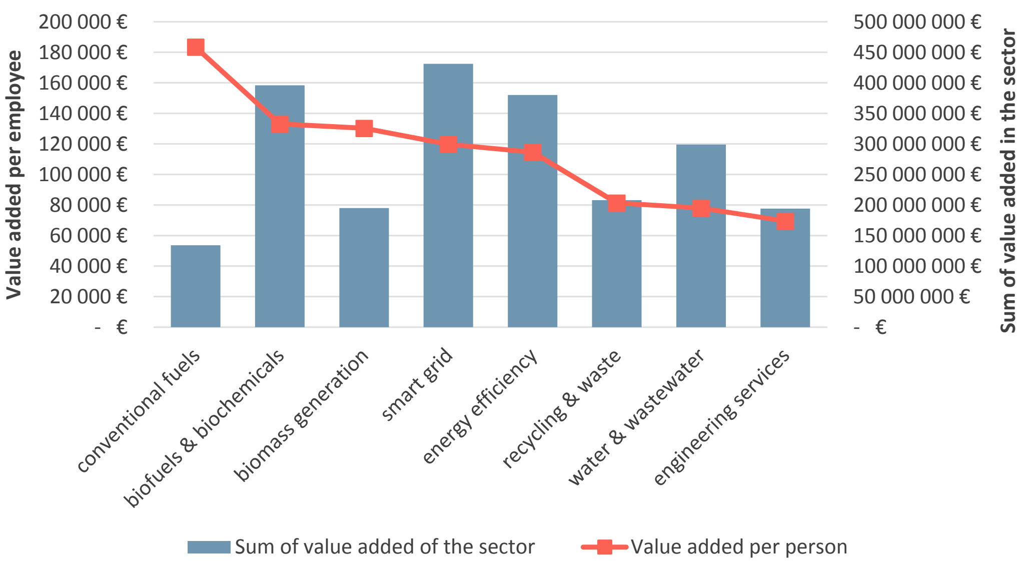
Value added – Smart Grid, biofuels and energy efficiency sectors contribute most to the economy

To gauge the real impact that industrial activities have on a country's economy one has to look beyond mere company frequencies. The foremost indicator economists pay attention to is the *value added*. "The value added measures the total value added produced by the various factors of production in an establishment's [here the companies'] actual operating activities."[19] In more operational terms, the *value added* is calculated as the sum of *labor costs*, *depreciation and amortization*, *rents*, and *profits*. Alternatively, one can subtract the cost of all *factors of production* that have been produced outside the company – i.e. *procurements* – from a company's *revenue*.

The *value added* can be calculated for entire sectors by adding together the *value added* of companies that comprise it. The *value added* is an important measure for the purposes of *economic development* because, by definition, it quantifies the net volume of local, regional, or national production. Typically, the *value added* positively correlates with *employment*, one of the key metrics keenly monitored by *economic developers*.

Figure 2.4 reveals that, in absolute volumes, the *Smart Grid* (€431M), *biofuels and biochemicals* (€396M) as well as *energy efficiency* (€380M) -sectors generate the most value added. The eight sectors depicted in the figure produce nearly 75% of the value added of the whole Cleantech space captured by the data. The giants, as defined earlier,

Figure 2.4
Value added by Cleantech sector



have been excluded from the analysis. Note that *renewable energy generation* would rank second with a total value added of €429M if it were treated as an integrated sector.

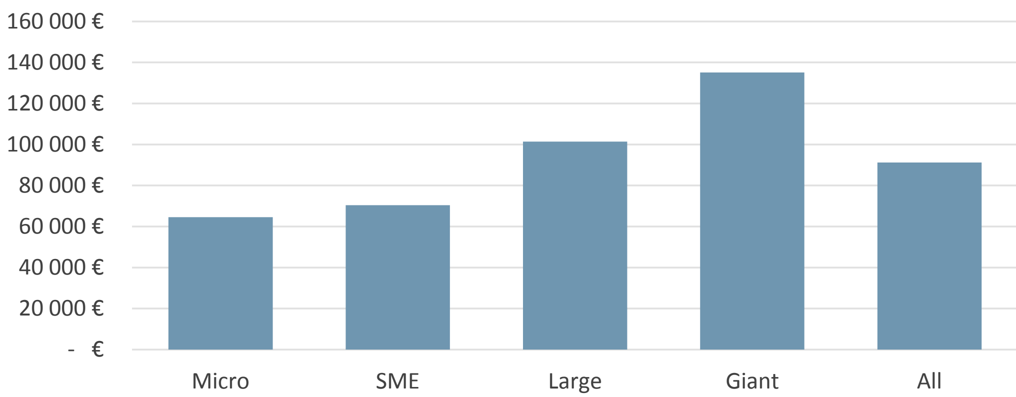
It is interesting to see that populous sectors such as *water and wastewater treatment* as well as *recycling and waste* do not generate value added in proportion to the sectors company frequencies. This can be a function of many factors such as comparatively lower revenues, smaller average company size or a higher share of factors of production procured from outside the sectors.

The value added can be also harnessed to determine the productivity of employment – i.e. the value added per employee[20] – within sectors. Figure 2.5 demonstrates that absolute value added does not necessarily always coincide with the average value added per employee. Productivity seems to be especially high in the *conventional fuels* -sector, which produces comparatively little value added. The average value added per person in the sector is over €180,000, more than twice as much as in the *recycling and waste* as well as *the water and wastewater treatment* -sectors. *Biomass generation* is another highly productive sector when compared to its absolute value added. For a breakdown of the average value added per employee by company size, please consult Table 2.1.

Performance – Overall returns are decent but SMEs, in particular, struggle with profitability

The financial performance[21] of companies can be measured with a number of indicators. Here, we employ four: *return on assets* (ROA), *return on equity* (ROE), *earnings before interests and taxes* (EBIT), and the *profit margin*.

Figure 2.5
Average value added per employee by company size



Breaking down the data by company size, Table 2.1 clearly shows that, on average, small companies in particular struggle with profitability. While the strongly negative results for *micro-sized businesses* can still be argued to reflect expected patterns for businesses in the *pre-revenue phase*[22], the figures for *SMEs* are somewhat alarming.

Given that *SMEs* in general are considered the backbone of economic stability as well as the engine for *economic renewal* and *job creation*[23], the long-term financial health of *SMEs* is essential for the buildup of a viable and thriving Cleantech ecosystem in Finland. While investors, in theory, still have been able to appropriate decent average returns (12% ROE), the *financial sustainability* of *SMEs* in the Cleantech space needs attendance. An average operating margin of -7% is a clear signal of financial distress unless it is not the random result of normal temporal variation that can occur in cross-sectional, single-year (2012) data such as those used in this report.

On a more optimistic note, large companies fare much better

The fact that the indicator has been constructed as a *weighted average* value of *all SMEs* in the sample, however, clearly argues against this possible explanation. Averages are much less prone to suffer from variation-related effects as the aggregate results tend to converge towards the mean. Also, when benchmarked against the excluded cohort of companies in supporting industries, Cleantech-intensive companies indeed fare far worse; another argument in support of the robustness of the overall finding. On a more optimistic note, large companies fare much better which, on the other hand, is quite intuitive given the universal *survivor bias* that grows with the average age of businesses in statistical datasets: only profitable companies survive in the long-term.

While profitability is seemingly low, the story is not necessarily as gloomy from an investor's point of view. According to Statistics Finland, the average *Return on Assets* (ROA) percentage of the entire Finnish industry in 2012 was 5.4%; for *SMEs* the figure was 4.4%. The cor-

Table 2.1
Financial performance by company size, %

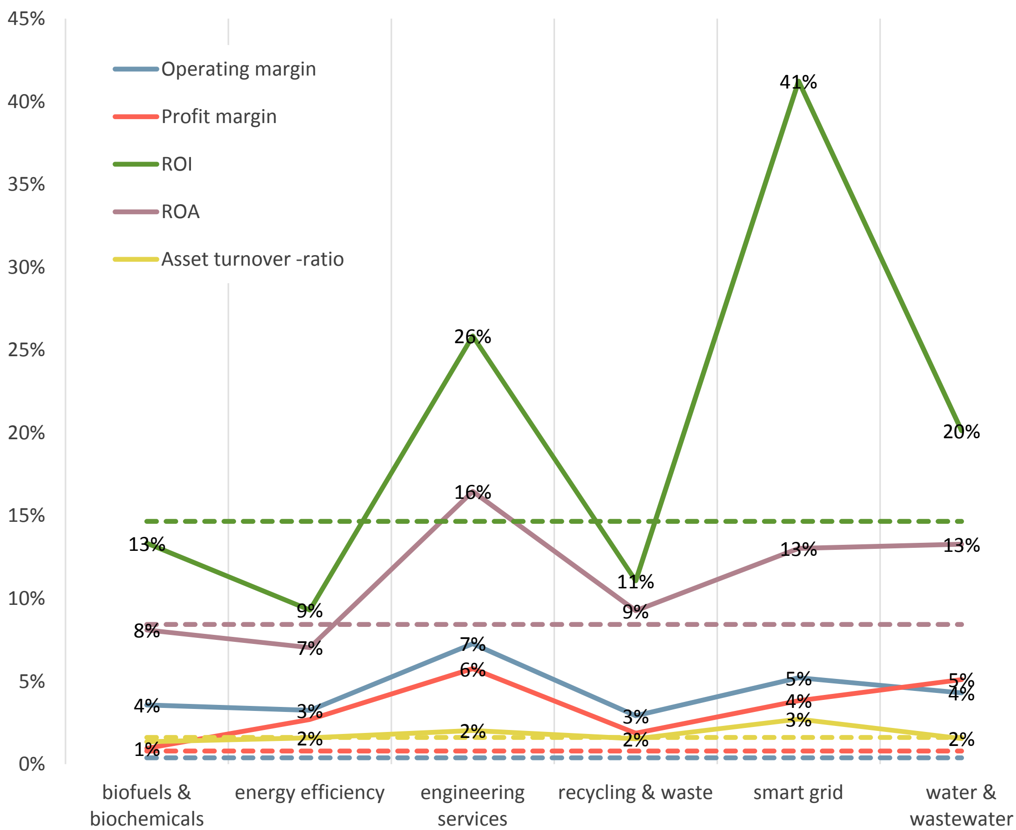
	Micro	*SME*	*Large*	*Giant*	*All Cleantech*
Operating margin	-42	-7	4	2	0
Profit margin	-46	-10	5	6	1
ROI	0	12	16	16	14
ROA	1	7	9	9	8
Asset turnover ratio	2	2	2	1	2

responding figures for the Cleantech space are 6.9% and 8.3%. The figures for ROE are even higher. While the returns have been smaller, they have been generated with lower *assets* and *capital inputs*.

The result can be interpreted in many ways. One is to say that the Cleantech space is *undercapitalized* but has capital-efficient companies. The intrinsically efficient companies generate smaller profits simply because they have been unable to tap into large enough pools of resources or are unwilling to invest into growth. Reasons can be manifold, ranging from the inability to raise financing and the smallness of targeted markets to a reluctance to grow. Be it as it may, given the fairly good efficiency and large enough growth opportunities, larger capital inputs should result in higher profits. This doesn't hold true for loss-making companies, of course.

A less flamboyant interpretation is of statistical nature. As shown earlier, the companies in the Cleantech space are significantly larger in terms of revenue and personnel when compared to Finnish companies in general. These, and the differences in other dimensions such as in-

Figure 2.6
Financial performances by Cleantech sector



dustry distribution, might play a significant role in the statistical differences in the observed profitability indicators. In order to pin down the causalities behind the differences more profound statistical analysis is needed.

To complement the discussion, we can also look at the financial performance of Cleantech companies *by sector*. Figure 2.6 shows the results for the six largest sectors as measured by value added. A closer look reveals that the companies in these sectors financially outperform the rest of the Cleantech population on average[24] (population averages shown in dashed lines). With a six and five percent profit margin, respectively, the *engineering services* and *water and wastewater* -sectors generate the highest profits. Both are still below the average general industry benchmark of seven percent. The *Smart Grid* and *energy efficiency* -sectors trail in third and fourth places with four and three percent margins, respectively. The lowest profit margins are found in the *agriculture and forestry* (-151%), *hydro and marine power* (-88%), *solar power* (-47%) and *nuclear power* (-34%) -sectors that are not reported in the table. Note that some of the latter sectors have very low company frequencies such as *agriculture and forestry* (6 companies) and *hydro and marine power* (6 companies).

The investment-related performance indicators show a lot more potential

The investment-related performance indicators show a lot more potential. Some of the Cleantech sectors clearly outperform the general Finnish industry, which on average returns 14 percent on investments. Smart Grid (41% ROI), engineering services (26% ROI and 16% ROA) and water and wastewater treatment (20% ROI) are the most notable examples. Again, the *agriculture and forestry* (-35%) as well as *solar power* (-12%) are the poorest performing sectors.

Intellectual property rights – Do patents uncover a deficiency in consumer-oriented solutions?

Intellectual property rights are used for a plethora of purposes in research. Ranging from a measure of innovativeness to a tangible support in tracking technological evolution, patent data in particular are a widely used resource to probe the inherently fuzzy and ambiguous dimension of innovation.

Patent data surely have their flaws. Patents are only one form of intellectual property protection, and many times companies revert to other methods such as secrecy or lead-time. Hence, patents are in no way an exhaustive, all-encompassing measure. Patenting practices also differ from industrial sector to the other, making comparisons challenging.

Here, patents are used to describe the technological space of Finnish Cleantech. What specific technological fields does Finnish Cleantech comprise of?

As a word of caution, we need to point out that especially *software*, *data* and *service-based* businesses are strongly underrepresented in the following analyses for the sheer fact that they are not patentable in the European context; another flaw of patent data as a statistical proxy for innovation and technology.

It seems that many of the businesses in the Cleantech space are not necessarily built around proprietary technology

That being said, 192 out of the 760 Cleantech companies in the data – one quarter of the population – hold at least one patent. For an allegedly technology-driven industry it is not an exceptionally high share. It seems that many of the businesses in the Cleantech space are not necessarily built around proprietary technology. In total, the companies hold roughly 13 000 patents, of which more than 9700 are owned by Nokia. The majority of other patent holders in the data hold only a few patents: less than 20% boast more than 10. In the following analyses the giants, including Nokia, are excluded.

To help in a structured analysis, the patents are categorized according to a patent classification. The classification used in this report is developed by Mancusi[25] and encompasses six broad technological fields: *electronics*, *instruments*, *chemicals and pharmaceuticals*, *processes*, *machinery* as well as *consumer goods and civil engineering technologies*. These six categories are further divided into 30 technologies.

Actively patenting companies operate most frequently in the manufacturing industry

As Figure 2.7 reveals, the majority of the patents[26] reside in the categories *mechanical*, *process*, or *electrical engineering*. To no surprise, actively patenting companies operate most frequently in the manufacturing industry: out of the 174 companies that have at least one patent, more than 100 are in the manufacturing industry.

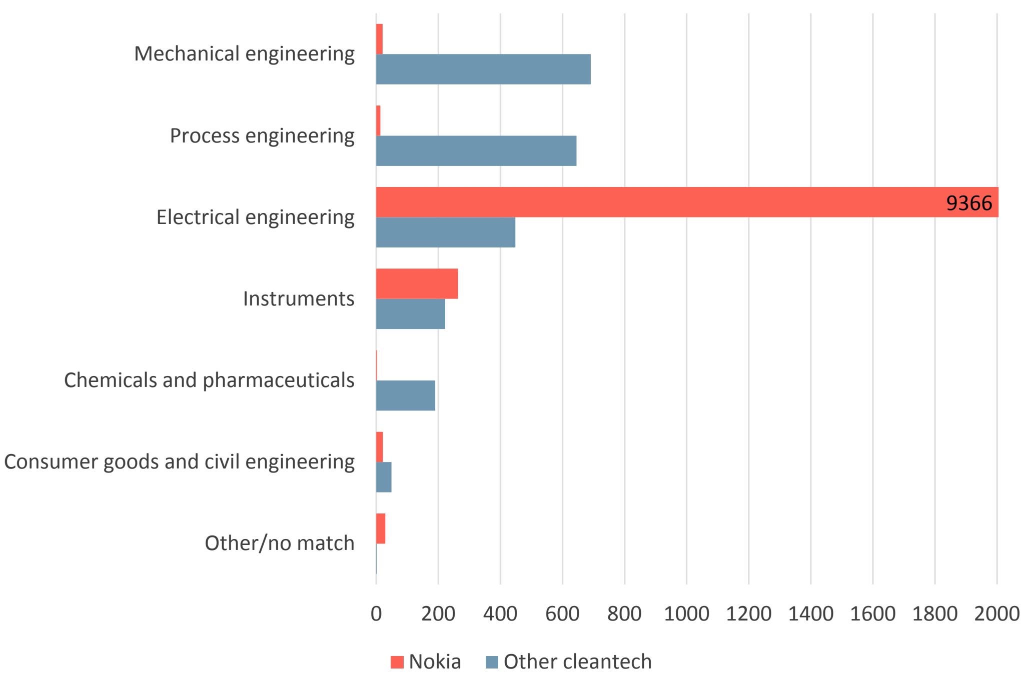
Consumer-oriented technologies are clearly underrepresented; a result, which gives rise to a very interesting discussion on the dangers of Finnish Cleantech companies missing out on the massive growth opportunities that consumer markets currently offer. Let us elaborate:

Three sectors, in particular, put major strain on the sustainability of consumption of planetary resources today: *Transportation*, *food and feeds*, and *housing*. In all three sectors it is consumers that drive the overall consumption. Hence, many companies around the globe that could be branded Cleantech are developing solutions geared towards motivating consumers to adopt more resource-efficient practices (Uber, Airbnb, Revolv, SmartThings). According to a rule of thumb, one unit saved in consumption translates into three units saved in production. The combined effect on resource consumption can be exponential.

Sure, a large share of these solutions is service and software -based and will not show up in patent statistics for the simple reason of not being patentable in Europe. Hence, a lack of patents in consumer-related technology is not necessarily alarming, but many of these services encompass a technological component in the form of sensors, transmitters, receivers, terminals etc. that might involve opportunities for developing proprietary technological solutions. These should show up as patenting activity. In the US, the types of patents addressing the consumer markets through ”*cleanweb*” products encompass mobile device applications, place-based (e.g. GPS) tracking and decision support systems, logistics, and driver or product rating strategies. However, the US Supreme Court narrowed the type of inventions that are eligible for patents, such as methods that are merely computer- or cloud-based applications of familiar ideas, such as financial transactions or price-based models[27].

A closer look at the three engineering patent categories reveals that *electronic devices and electrical engineering* (electrical engineering), as well as *handling and printing* (mechanical engineering) are clear-

Figure 2.7
Breakdown of Cleantech patents by technological field



ly the two single most important technology categories that Finnish Cleantech companies patent in (see Figure 2.8). To clarify, the category *handling* includes patents on packing, storing, lifting, and hauling technologies. *Surface technologies* and *thermal processes* (process engineering) are the next most frequent categories.

Breaking down patenting frequencies by Cleantech sector, in turn, shows that sectors with large numbers of companies also tend to have the most patents (see Figure 2.9). More than one third of all patents are held by companies that operate in the sector *energy efficiency*.

Figure 2.8
Breakdown of engineering patents by subcategory

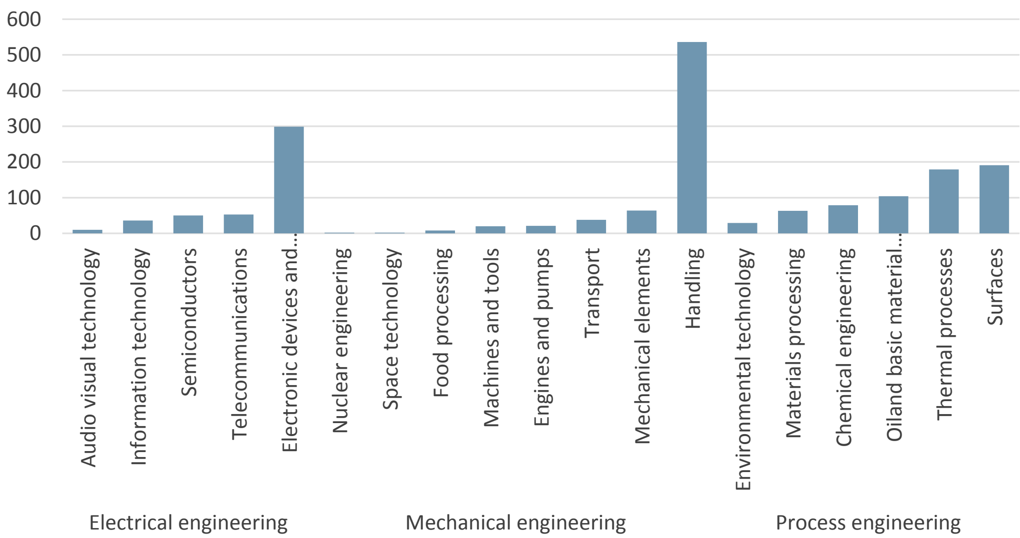
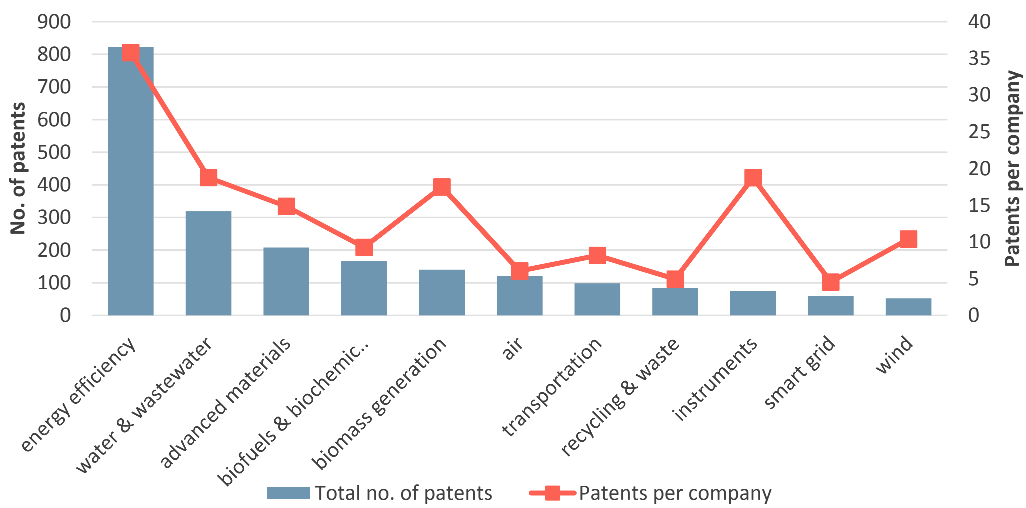


Figure 2.9
Total number of patents and patents per company by Cleantech sector



The result is intuitive. First, *energy efficiency* is a very loosely demarcated sector that covers manufacturers and developers of products and services that are exploited across other Cleantech sectors. The interpretation finds support in the division of the *energy efficiency* companies across conventional industry classes: while companies in the Cleantech sectors *cables*, *metals*, and *electronics* all operate in the *manufacturing* industry, *energy efficiency* is a lot more diverse. It comprises companies that operate in the *manufacturing*, *construction*, *wholesale and trade*, *ICT* and *R&D* industries.

Second, many argue that the purpose of Cleantech, first and foremost, is to facilitate an efficient exploitation of resources. Hence, energy efficiency, by way of definition, can be expected to encompass a fairly large share of companies. This reflects on the sheer volume of immaterial property generated in the sector. Not only is the total number of patents high, but the number of patents per company clearly outshines the equivalent figure in any other sector. To avoid misleading interpretations of the result, we should emphasize that the finding is partly explained by the bigger size of the companies in the *energy efficiency* sector. Please note again that the giants are not included in the analysis.

The bottomline – Are the manufacturing focus and financial distress of SMEs a drag on the long-term viability of the Finnish Cleantech space?

Ever since its break with an agrarian base, the growth of the Finnish economy has been spearheaded by high-profile, engineering- and manufacturing-driven companies such as Outokumpu, Wärtsilä, Metso, Kone, Nokia, Rautaruukki, and UPM. Hand in hand, the reverence of engineering skills and education has shaped the perceptions of the professional hierarchy in the country. Only the rare brain surgeon bests the engineer in public respect, and only for the reason that Finnish rocket scientists are close to non-existent. It is quite descriptive that, in the aftermath of the latest economic crisis in Europe, the Finnish public started discussing the threats of mass unemployment really only after the unemployment rate of engineers, thought untouchable, soared to an all-time high beyond 4.5% in 2014[28]. Finland has a legacy in engineering; there is no denying the fact.

The reverence of engineering skills and education has shaped the perceptions of the professional hierarchy in the country

Our results strongly reflect this legacy. The data provided by the central stakeholders in the economic development of the country show that manufacturing businesses are the clear center of gravity in the Cleantech space, even more so than in the Finnish industry in general.

It is fairly irrelevant whether this is because of a perspective economic developers in Finland have adopted or because the majority of Finnish Cleantech companies are engineering-driven. What matters is that, in the gold rush era of digitalization, a heavily manufacturing- and engineering focused company base can quickly become the ball and chain to the mid-to-long-term growth of the industry.

In the gold rush era of digitalization, a heavily manufacturing- and engineering focused industry can quickly become the ball and chain to economic growth

Let us exemplify. Ford Motor Company, one of the world's best known car manufacturers, is looking ahead: In the light of recent developments in digitalization, big and open data, and the diminishing interest in owning vehicles amongst the younger generations, the company has estimated that in ten years 80 percent of the value of the car will reside *outside* the car. The vehicle is expected to turn into a commoditized sensor platform, vacuuming data on the vehicle's environment and the behavior of its passengers, only to be fed to third parties for business development. While the car is turning into a moving hardware platform for the mobile office, entertainment center and shopping mall, it is the data analytics businesses, online retail brands, insurance companies and other service providers who will reap the profits generated by business models built on top of the commoditized, low-margin car as a hardware platform. Hence, Ford is asking itself the strategic question whether it should actually move up the vertical and horizontal value chains to position itself as a technology company, as its CEO recently did at the Consumer Electronics Show in Las Vegas. Hanging on to the legacy seems to come with the risk of being pushed to the proverbial periphery of the new, emerging e-mobility ecosystem[29].

Hanging on to the legacy seems to come with the risk of being pushed to the proverbial periphery of new, emerging ecosystems

Similar stories could be told about the emerging Smart Grid ecosystem, where telcos and data analytics companies currently fight for dominance of the demand-response space, an area in which power utilities *should* reign superior.

That being said, where are all the service businesses in the Finnish Cleantech space? Where are the Finnish equivalents to Lyft, EnerNOC, Stem, Uber, Airbnb, etc.? Not on the lists of Finnish economic developers, it seems. And we cannot blame them. Even for a scholar of industrial renewal, these businesses are extremely hard to find. Many of the companies are still in the startup phase. Peloton Club, an accelerator focusing on consumer Cleantech solutions for Finnish efficiency companies and run by DEMOS Helsinki, caters to the needs of young companies that develop new consumer solutions for more sustainable energy usage: Peer-to-peer courier service provider PiggyBaggy; Fourdeg, an intelligent thermostat company; Weegos, a service that turns city-owned vehicles into a car fleet in joint use; Sharetribe, a sharing-economy platform enabling peer-to-peer exchanges; Moralguard, an application to help consumers shop according to their values; and Re-Pack, a packaging system for online retailers and shoppers whereby delivery packages can be returned. These companies are heralds of growing service-based activity in the Finnish Cleantech space, which clearly needs urgent redefinition to accommodate more businesses outside the engineering domain.

These companies have earned the honorary title of pioneer for yet another reason: their offering is mainly geared towards consumer markets. As demonstrated earlier, preliminary evidence shows a deficiency in Finnish innovations in the consumer domain – a finding that is in support of a disproportionately engineering-driven take on Cleantech in the country. Consumer markets should not be neglected in the development of Finnish Cleantech. Among the four fastest growing businesses[30] in the world, three *consumer brands* have wedged themselves a position: Apple, Google and Microsoft. With the proliferation and mass adoption of *smart consumer technologies* as well as global trends such as the *quantified self* -movement, *open data, smart city* and the rise of the *internet of things*, we have barely witnessed the kindling of the potential wildfire that will sweep over our way of living and hopefully will see to wide-reaching improvements to overall economic, social and ecological sustainability in the very near future.

With the proliferation of smart consumer technologies we have barely witnessed the kindling of the potential wildfire that will sweep over our way of living

To ride the Cleantech wave as a global forerunner necessitates catching and harnessing the riptide of change in the consumer domain. In a best possible scenario, it will be an integral part of a Finnish Cleantech ecosystem that complements the already existing skeleton of manufacturing- and engineering-driven company base. What the sector needs now is open-mindedness on part of economic developers for a broader view of Cleantech, adventurous courage on part of the existing industry and the government for opening its current technology platforms as well as databases for new service-based business models, and more growth-oriented businesses which pioneer consumer markets with service-based smart solutions.

To ride the Cleantech wave as a global forerunner necessitates catching and harnessing the riptide of change in the consumer domain

To do so means that the industry needs to learn to closely test prototypes with their customers throughout the entire product or service development process in continuous and iterative validation cycles. Nothing drives concept development forward more effectively than time spent with actual customers. The best founders, CEOs and senior managers spend significant amounts of time with the clients. It is not an activity they delegate. Most importantly, however, what is dearly needed, is the creation of new types of cross-industry partnerships that form a solid base for green innovation ecosystems. The state, municipalities and companies, big and small, with a wide range of backgrounds from manufacturing to digital services, need to learn ways and practices to collaborate. This is an absolute prerequisite for the industry's mid- and long-term development.

A Cleantech ecosystem is unfathomable without a healthy base of SMEs, the only trailblazing force across incumbent, locked-in industry structures

That being said, a more hands-on and urgent challenge that needs to be tended to immediately is the poor financial viability of small and medium sized businesses in the Cleantech space. Our results are merely descriptive and do not provide information on the reasons behind the lackluster performance of the most crucial drivers of industrial renewal. Is the problem traceable to the current European-wide economic downturn, perhaps? Are investors overly cautious because of it? Or are Cleantech SMEs in Finland either too young to or still in the process of defining their business models to become profitable? We cannot tell. One thing is certain: a Cleantech ecosystem is unfathomable without a healthy base of SMEs which, many times, are the only trailblazing force across incumbent, locked-in industry structures.

A path forward – Redefining the Finnish Cleantech opportunity in the age of digitalization

Since 2003, when the term Cleantech first came in vogue, it was defined along industrial verticals that relate to physical infrastructure systems and legacy industries, such as energy utilities (e.g. wind power, solar power), water utilities (e.g. water treatment, membranes), and specialty electronics companies (e.g. solar lighting, LED). The *make-and-sell* business model, the stalwart of the *traditional Cleantech economy* is slowly being eroded by service models with recurring revenue streams and low capital intensity.

The make-and-sell business model, the stalwart of the traditional Clean-Tech economy is slowly being eroded by service models

To exemplify, consider how Bloom Energy, a company that makes utility-scale fuel cell energy storage systems, replaced its revenue and business model from sales transactions, to lease and power purchase agreements, which allowed it to scale its turnover and profit margins. Compare First Energy, a solar panel manufacturer, and Solar City, a solar energy provider through brokerage and long-term power purchase agreements. In terms of all financial metrics, Solar City comes out on top: capital efficiency, revenue growth, margins.

CleanTech 2.0 has been defined by business models that have been *built on top of legacy infrastructure*, and has given rise to the *cleanweb*. The *cleanweb* reflects the *convergence* of several technology megatrends, including: The *explosive growth of data* from sensors and networked devices; Increasing *connectivity* and *automation* among devices; the *falling price of computing power* and rise of "big data" *analytical capabilities*; the growth of *smartphone ownership*; the emergence of *new consumer behavior* on social networks and other platforms.

Cleanweb is to be understood very broadly. It is a *paradigm shift*, not a buzzword referring to the development of nifty smart apps only. *Cleanweb* companies sit at the nexus of traditionally disparate industries and functions, and have resulted in the collapse and cross-integration of value chains. They by-pass traditional market channels and no longer depend on governments for subsidies or tax breaks. If anything, government and patenting policies are playing a catch up game in terms of regulation and customer privacy protection. Their business models are wide and varied, and tend to be tailored to the end-customer, which allow for speed to market and scale.

Cleanweb is changing consumer behavior, making people think differently about how they interact with devices and legacy industries that are 100 years old

Cleanweb is driving different consumer behaviors. It's making people think differently about how they interact with devices and legacy industries that are 100 or 150 years old. In the process, they drive adoption of Cleantech products. The consumer drives the adoption of the technology through a service model.

As stated earlier, Finland has service businesses, but they are all start-ups and not much on the radar of economic developers. The economic driver needs to come from the established Cleantech companies – they clearly have a financial pain point as amply shown in this report. The redefinition that needs to happen is the transition from make-and-sell to *digitalized service* business models – shifting the cost structure of doing business. ICT and network-based technologies are at the core of the transition from Cleantech to cleanweb.

A decade after Cleantech was launched as an innovation space, the convergence between ICT and Cleantech holds the key to scale and profitability. Given the pre-eminence of Finnish companies in this area, and a rich industry value system in this space, there is clearly an opportunity to be tapped and assets to be leveraged. Fortunately, the sentiment in the Finnish Cleantech space itself is upbeat. In fact, a lot more upbeat than in other sectors of the Finnish economy, as a survey administered to Finnish SMEs in early 2015 reveals[31]. Motivation and optimism carries a long way.

References

1 WWF & Cleantech Group (2014). Global Cleantech Innovation Index 2014 – Nurturing Tomorrow's Transformative Entrepreneurs. Download at: info.cleantech.com/CleantechIndex2014.html

2 The Economist (2008).Clean Technology in the Downturn – Gathering Clouds. NOV6, 2008. Read online at www.economist.com/node/12562281

3 van Lierop, W. (2014). Is cleantech the key to industrial structural change? Presentation at Cleantech Venture Day, Lahti, Finland, OCT28, 2014.

4 Bloomberg New Energy Finance.

5 WEF (2014). Global risks 2014. Ninth edition. www3.weforum.org/docs/WEF_GlobalRisks_Report_2014.pdf. (Last access JUN3, 2016)

6 PriceWaterhouseCoopers (2014). Global Top 100 Companies by market capitalization. 31 March 2014 update. IPO Centre, UK.

7 KPMG (2014). What are the global megatrends. www.kpmg.com/global/en/issuesandinsights/articlespublications/future-state-government/pages/what-are-the-global-megatrends. aspx. (Last access NOV 7, 2014). PWC (2014).

8 DARA Group and Climate Vulnerability Monitor (2010). A Guide to the Cold Calculus of a Hot Planet. www.daraint.org.

9 New York Times (2013). Large Companies Prepared to Pay Price on Carbon. www.nytimes.com/2013/12/05/business/energy-environment/large-companies-prepared-to-pay-price-on-carbon.html. (Last access JUN3, 2016).

10 GSI (2010). Delivering on G-20 commitments: The path to fossil-fuel subsidy reform. Policy Brief. IISD, Canada.

11 TEM (2014). Strategic Programme for the Cleantech Business. www.tem.fi/en/current_issues/pending_projects/project_and_programme_archive/strategic_programme_for_the_cleantech_business (Last access JUN3, 2016)

12 Carbon Tracker Initiative (2013). Unburnable Carbon – Are the world's financial markets carrying a carbon bubble? www.carbontracker.org/report/carbon-bubble/. (Last access JUN3, 2016).

13 The Atlantic (2013). The Carbon Time Bomb in Your Retirement Account – A new financial tool lets Wall Street calculate the climate-change risk of investments. m.theatlantic.com/technology/archive/2013/12/the-carbon-time-bomb-in-your-retirement-account/282139/ . (Last access JUN3, 2016)

14 UN (1997). Glossary of Environment Statistics, Studies in Methods, Series F, No. 67, United Nations, New York, 1997.

15 Gewirtz, P. (1996). On 'I Know It When I See It'. Yale Law Journal, Vol. 105, pp. 1023–1047.

16 Bunting, J. (2014). The Rise of Cleanweb and the Opportunity for Corporates, Cleanweb White Paper, CleanTech Group, San Francisco, CA.

17 Source: Statistics Finland.

18 The classification is based on the authors' views and is therefore subjective. In the case that a company operates in more than one cleantech sector, the most focal sector was chosen.

19 Source: Statistics Finland.

20 As already noted earlier, the productivity index for the different sectors used here is weighted by the companies' number of employees.

21 The outliers have been treated by using a winsoring method; 2,5% of the extreme values are set to the value of the 97,5th percentile. The averages are weighted using the number of personnel.

22 In the data, there is significant positive correlation (95% significance level) between company age and size.

23 66,5% of European jobs were provided by SMEs in 2012 (European Commission, 2013).

24 Outliers have been subjected to 90% Winsorization: indicator values below the 5th percentile have been set to the 5th percentile, and values above the 95th percentile have been set to the 95th percentile. In addition, the averages are weighted using the number of personnel. Giants are excluded from the analysis.

25 Mancusi, M. L. (2003). Geographical Concentration and the Dynamics of Countries' specialization in technologies. Economics of Innovation & New Technology, Vol. 12, No. 3, pp. 269–291.

26 The patents of the "giants" are excluded from the analysis.

27 http://www.supremecourt.gov/opinions/13pdf/13-298_7lh8.pdf; Alice Corporation PTY. LTD. v. CLS Bank International et al.; October 2013.

28 TEK (2015). http://www.tek.fi/tutkimus/tyollisyystilastot (last accessed on JAN 19, 2015).

29 Crothers, B. (2015). "Apple Car Is Sign Of Mapping Push By Tech Companies." FEB 2015, Forbes Magazine.

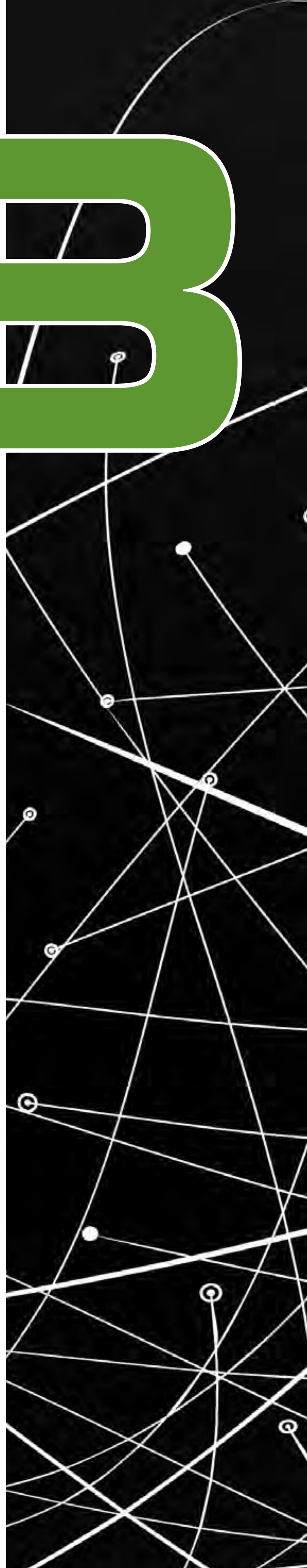
30 PriceWaterhouseCoopers (2014). Global Top 100 Companies by market capitalization. 31 March 2014 update. IPO Centre, UK.31

31 The Federation of Finnish Enterprises (2015). SME-Barometer, Sector -report, Cleantech, Spring 2015; Helsinki, Finland.

3

Sourcing

Mapping Emerging Ecosystems as a Thematic Sourcing Strategy



Mapping Emerging Ecosystems as a Thematic Sourcing Strategy

> *Growth demands a temporary surrender of security. It may mean giving up familiar but limiting patterns, safe but unrewarding work, values no longer believed in, and relationships that have lost their meaning.*
>
> – John C. Maxwell, Author

Multi-Asset Renewal Funds enable institutional investors to efficiently put their capital to work for the growth of thematic industry sectors and the renewal of the real economy. As we argued in the previous chapter, growth in the digitalizing world is cross-industrial and is best observed in newly emerging value networks of transactional relationships between companies. Many employ a more generic term borrowed from nature: the ecosystem.

Growth in the digitalizing world is cross-industrial and is best observed in newly emerging value networks of transactional relationships

To both efficiently and effectively invest in such ecosystems of companies, we need to establish a valid *investment thesis* that links emerging industrial ecosystems as an economic phenomenon to the investment model of MARFs as a technical solution and provides the intuition for why it all makes sense from an investor's point of view.

In the remaining chapters of the book we construct, step by step, the investment thesis for MARFs. To do so we must begin with the foundations. If ecosystems are to be the ultimate investment target for MARFs, it is natural to start with the following two questions: What are ecosystems in the first place and how does one go about identifying them?

Definition: Investment thesis

"An investment thesis is the beliefs that investors decide to use when determining what investments to purchase or sell, when to take an action and why. An investment thesis helps investors establish goals for their investments, and measures whether they have been achieved, either in written form or simply as an idea. A sound investment thesis can be a foundation for a profitable portfolio. On the other hand, an incorrect investment thesis can result in sub-par returns or losses."

Source: Investopedia.

Industrial ecosystems borrow from nature for concept

In natural sciences ecosystems are characterized by a network of interactions among individual organisms, the elements and the environments in which they act[2]. While interactions can be physical encounters between individual organisms, many of them are indirect exchanges of material and energy[3] that "flow" and are passed on through the ecosystem across time, changing state and form in doing so. Ecosystems are often contained in demarcated geographical spaces and form self-sustaining and intradependent sub-systems of the Earth's ecology.

In an industrial setting, recycling of materials within and across industries has long been known by the concept of circular economy

Analogies between natural and industrial ecosystems rest on principles that both share on a conceptual level. Korhonen[4], for instance, identifies four such principles.

The principle of *roundput* dictates that, in a healthy ecosystem, materials are recycled among its actors and, in parallel, energy cascades from one organism to the other via interaction in the environment. In an industrial setting, recycling of materials within and across industries has long been known by the concept of *circular economy*[5]. In the circular economy, waste and side-products of any one company serve as factors of production for others. While natural ecosystems are highly efficient at recycling organic and elemental matter, industrial ecosystems throughout history have produced lots of harmful excess material that has remained unused and is harmful to the environment at worst. With the rise of efforts towards greening economies, the issue of plugging the leaky circulatory systems of material and energy in and between industries has been taken more and more seriously.

The issue of plugging the leaky circulatory systems of material and energy in and between industries has been taken more and more seriously

Diversity also increases the robustness of the entire ecosystem because it becomes less dependent of any one individual or species

The principle of *diversity* calls for a critical amount of sufficiently different species and organisms in a system. Diversity increases resource efficiency because individual organisms are able to specialize and become highly adept in utilizing resources. Diversity also increases the robustness of the entire ecosystem because it becomes less dependent of any one individual or species. Along the same line of argumentation the principle also calls for diversity in interdependencies, which introduces redundancy to the system. The extinction of one organism cannot upset the system because the necessary resources can be obtained from a number of alternative organisms.

The principle of *locality* implies that organisms in an ecosystem make use of local resources, all the while respecting their natural limitations set by the environment. In natural ecosystems, collaboration between organisms takes place in local environments. To draw the parallel to economic and industrial ecosystems, Porterian clusters[6] resembled local ecosystems in many aspects in the era preceding hyper-globalization. Entire value chains were co-located in areas of high industrial agglomeration, processing resources from raw materials all the way to end products. Globalization and digitalization have made it possible to extend the boundaries of industrial ecosystems beyond their geographical and natural limitations. They have become agnostic of distance and restrictions such as culture, language or currency. Today, ecosystems are truly global. Global is the new local.

Globalization and digitalization have made it possible to extend the boundaries of industrial ecosystems beyond their geographical and natural limitations

Finally, the principle of *gradual change* describes how ecosystems evolve by way of slow changes in the diversity of organisms. These changes occur through reproduction: via natural selection new generations are better adapted to changes in the ecosystem and have a competitive edge over other species fighting for shared resources. Industrial evolution is very much alike, as young, innovative companies pick apart – or unbundle, to be more precise – the businesses of large incumbents one business line at a time. It has also been shown that the assets of failed businesses often find more effective use in new companies that have figured out a better way to exploit them[6]; a phenomenon one could refer to as *intergenerational adaptation*. As we will shortly see, the emergence of ecosystems in the Cleantech space is indeed led by agile digital businesses that latch on to the capital intensive infrastructure of large legacy industries and capture most of the value new ecosystems have to offer. Blazing the way for some actors, rendering the business models of others obsolete and creating the recipes for success for themselves, these companies gradually change the diversity of actors and their interaction in emerging ecosystems.

Data on financial transactions reveal the structure of emerging industry ecosystems

The four principles of roundput, diversity, locality and gradual change can be put to use in identifying emerging economic ecosystems that are healthy and sustainable in the long-term. The process starts with mapping the fundamental structure of the ecosystem. To map the structure we need to determine the key actors in the ecosystems and figure out how they interact with each other.

Industrial structures, fundamentally, are chains and networks of financial and transactional interactions between companies. These include supplier-client relationships, joint ventures, alliances, and R&D collaborations. Independent of the nature of interaction, the relationships involve business transactions between two or more companies and can, in the majority of cases, be quantified by the volume of monetary or resource flows.

To find proof of any given ecosystem, we need to uncover transactional and financial network relationships between the companies

In alignment with Porter's[8] concept of the value chain, the configuration of these relational patterns and the variety of functions that companies provide to each other characterize the structural boundaries and the thematic value added of any given industry ecosystem. In today's globalized economy, value chains are many times interlinked across conventional industry boundaries to form networks of cross-industrial value chains. It is these networks of interaction that we refer to as ecosystems.

Therefore, to find proof of existence for any given emerging ecosystem, we need to uncover transactional and financial network relationships between the companies that are active therein. Many methodological alternatives exist. The classic approach involves the use of input-output tables that show quantified value flows between industry sectors and are based on annual industry accounts. The data in the tables are highly aggregated, however, available mostly on the two-digit industry level. Mapping ecosystems at such low resolution will not truly lead to any applicable insights with regard to the nature of businesses that, in the end, define the theme of the ecosystem.

Therefore, we revert to Bloomberg's SPLC (Supply Chain) Module, a new database service by the news-group, which provides company-specific information on customers, suppliers, and competitive relationships with peers. For each relationship in the SPLC database it is possible to retrieve quantitative information on the estimated monetary flow and its direction between any two involved companies.

We are interested in understanding which specific industries play important roles in the emergence of new ecosystems

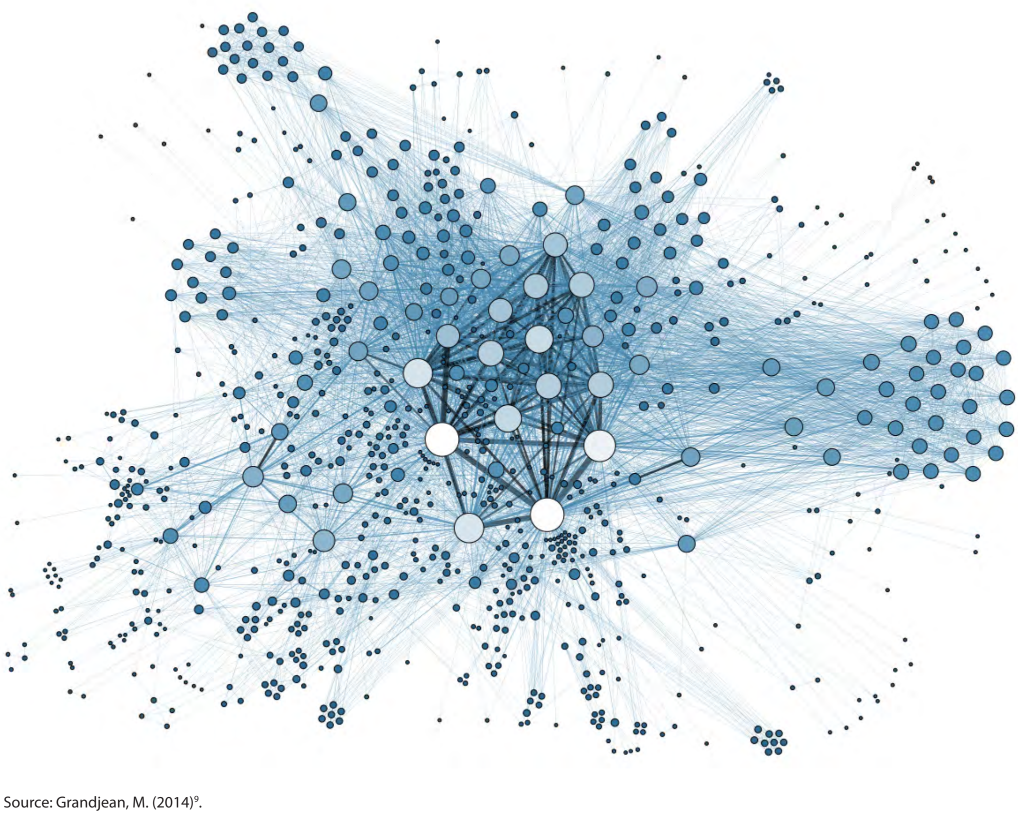
Furthermore, each company is assigned an industry code in a number of different industry classification systems (GICS, BICS, NAICS, NACE, etc.), a feature that allows for aggregation of data from the company level to the industry level when necessary. As we are interested in understanding which specific industries play important roles in the emergence of new ecosystems, this is a very handy feature indeed.

Combined, the features provide a powerful set of tools that enable analysts to roam and explore the financial network structures in any thematic ecosystem (see Fig. 3.1 for a generic example). Starting off with only a handful of companies known to operate in the ecosystem of interest, we can follow the links from one company to the next – both upstream and downstream along the various value chains – to unravel the complex relationship structure of the entire ecosystem.

The identification of the initial set of companies to start off with is fairly straightforward. For instance, when exploring the Smart Grid ecosystem it is safe to assume that power utilities, grid operators, electrical system manufacturers, certain telecommunications operators, smart meter developers, and data analytics companies will be involved.

That being said, choosing the actual companies to start the mapping process with involves some amount of qualitative due diligence – detective work including scanning published materials on the candidates' detailed business activities – to make sure they are representative and truly involved in developing their business in the ecosystem of interest. While

Figure 3.1
Example of a relational network map



Source: Grandjean, M. (2014)[9].

some telecommunications operators, for instance, have developed solutions such as machine-to-machine communication services for predictive electricity grid maintenance purposes, others have no interest in venturing into the Smart Grid space. To obtain a meaningful representation of the structure in the Smart Grid ecosystem, it is obvious that we have to exclude the latter and start off the analysis with the former.

The granularity in the relationship maps can be adjusted by either increasing or decreasing the degree of separation between companies along the value chains. The number of total connections in the map grows exponentially with each additional tier of companies as each newly added one entertains relations with numerous clients and suppliers of its own.

Once the total mass of individual companies reaches a satisfactory level, the industry codes associated with each company help in aggregating the data by industry. The individual company identifiers – i.e. names or ID numbers – are replaced by their industry classification codes to allow for aggregating individual connections between companies on the industry level. Based on the amount of individual connections, the respective amounts of financial exposure, and the degree of separation of industries it is possible to determine the connectivity and centrality – the importance, to put it more bluntly – of each involved industry in the ecosystem.

The most valuable feature of the approach is that it is purely data-driven

The most valuable feature of the approach is that it is purely data-driven. Beyond the selection of the often well-established and validated initial set of companies, there is no need to pre-specify the companies, industries or boundaries that demarcate the ecosystem ex ante.

Network visualization helps in interpreting complex ecosystem structures

Even after data aggregation, the output of the network analysis still remains difficult to interpret. Depending on what tools were used to perform the data aggregation, the results are usually produced in raw numeric format, viewable in the form of large, cumbersome tables.

To gain insights from the results, it is advisable to convert them into a more graphical form. To obtain a more spatial representation – such as the one presented in Fig. 3.1 – we utilized an open-source network visualization software called Gephi[10].

Most programs provide similar features and allow for a variety of them to be incorporated in the final visualization. As we knew that our maps would have to fit the book format, we opted for a two-dimensional map that expressed the relative roles of and relationships between industries via three key factors: relative distance between industry nodes, relative location of industry nodes, and thickness of the edges representing connections between industries. To avoid an overly technical treatment of the methodology here, we defer the more detailed description of the factors to our empirical showcases later in this chapter.

Beyond its visual features, the software provides the functionality to apply key metrics better known from social network analysis (SNA) on industry network analysis. These metrics include indices for betweenness, network centrality, closeness, clustering, average shortest path, etc. These indices, in turn, help in interpreting the importance and nature of roles that certain companies or industry sectors play in the analyzed ecosystems.

Catalyst industries connect multiple anchor industries, are characterized by greater network centrality and maintain multiple financial relationships outside their own cluster

As will shortly be illustrated by means of mapping three real-world ecosystems, the metrics will identify two types of industries in the network. On the one hand, *anchor industries* are characterized by low network centrality, and a predominance of clustered relationships as opposed to cross-industrial ones. These clusters, similarly to the clusters of nodes in Fig. 3.1, are a representation of the conventional and often linear value chains of anchor industries.

The cross-over between these anchor industry clusters occurs via intermediary industries, or *catalyst industries*, as we denote them. These catalysts are clusters of nodes that connect multiple anchor industries, are characterized by greater network centrality and maintain multiple financial relationships outside their own cluster.

Let us demonstrate.

Financial network mapping in action

Nothing helps to understand a methodology better than a practical application. In the remainder of this chapter we will focus on the application of the financial network mapping process on three distinct real-world cases: the Finnish Smart Grid, Smart Mobility and Green Chemistry ecosystems. For the reader who wants to first establish the larger empirical context of the ecosystems, Chapter 2 provided a general description of the Finnish Cleantech space that our case ecosystems are a part of.

We are by no means the first to use financial network mapping to unveil monetary flows in economic structures. Financial network maps have been used in a range of financial-economic systems – such as economic trade and interbank payment systems – to assess robustness and risk in interconnected financial systems. That being said, the application of financial network mapping to uncover emerging industry structures has, to our knowledge, not been attempted, but ties strongly into industrial cluster strategy approaches that have been advocated in economic development literature.

The grid has gradually become "smarter" as IT-enabled technology has been integrated into the legacy infrastructure

According to the Brookings Institution, a Washington DC think tank, industry cluster analysis can help diagnose a region's economic strengths and challenges and identify realistic ways to shape a region's economic future. Yet many policymakers and practitioners have only a limited understanding of what clusters are and how to build economic development strategies around them. To show the potential of network maps in generating novel insights for such strategies, we will provide implications for economic development in the concluding chapter.

Case Study 1: Smart Grid – Advancing efficiency, reliability and flexibility over legacy grid paradigm

Let us begin with mapping the Finnish Smart Grid space. Smart Grid as a concept is not a recent one, by any means. Demand-side management of electricity was among the earliest applications of a limited 'Smart Grid'. The grid has gradually become "smarter" as IT-enabled technology has been integrated into the legacy infrastructure of energy production, transmission, distribution and consumption. The proliferation of functionalities is reflected in many of the complementary definitions put forth by the various actors in the Smart Grid ecosystem:

According to the International Electrotechnical Commission (IEC)[11], a Smart Grid "is an electricity network that can intelligently integrate the actions of all users connected to it – generators, consumers and those that do both – to efficiently deliver sustainable, economic and secure electricity supplies. A Smart Grid employs innovative products and services together with intelligent monitoring, control, communication, and self-healing technologies to: (i) facilitate the connection and operation of generators of all sizes and technologies; (ii) allow consumers to play a part in optimizing the operation of the system; (iii) provide consumers with greater information and choice of supply; (iv) significantly reduce the environmental impact of the whole electricity supply system; and (v) deliver enhanced levels of reliability and security of supply."

The European Commission[12] adds that: "Smart Grids are energy networks that can automatically monitor energy flows and adjust to changes in energy supply and demand accordingly. When coupled with smart metering systems, Smart Grids reach consumers and suppliers by providing information on real-time consumption. With smart meters, consumers can adapt – in time and volume - their energy usage to different energy prices throughout the day, saving money on their energy bills by consuming more energy in lower price periods. Smart Grids can also help to better integrate renewable energy […]."

Compared to the legacy paradigm, Smart Grids offer multiple benefits to their various constituents, some of which are listed by the USDE[13]. These include "more efficient transmission of electricity; quicker restoration of electricity after power disturbances; reduced operations and management costs for utilities, and ultimately lower power costs for consumers; reduced peak demand, which will also help lower electricity rates; increased integration of large-scale renewable energy systems; better integration of customer-owner power generation systems, including renewable energy systems; [and] improved security."

Smart Grids create added value in the form of enhanced cost efficiency, greatly improved reliability and unprecedented production flexibility

To summarize, Smart Grids create added value in the form of enhanced cost efficiency, greatly improved reliability and unprecedented production flexibility. Because the related benefits are appropriated by both producers and consumers, the emergence of Smart Grids is driven by forces of both demand pull and supply push.

Smart Grids are cross-industrial ecosystems

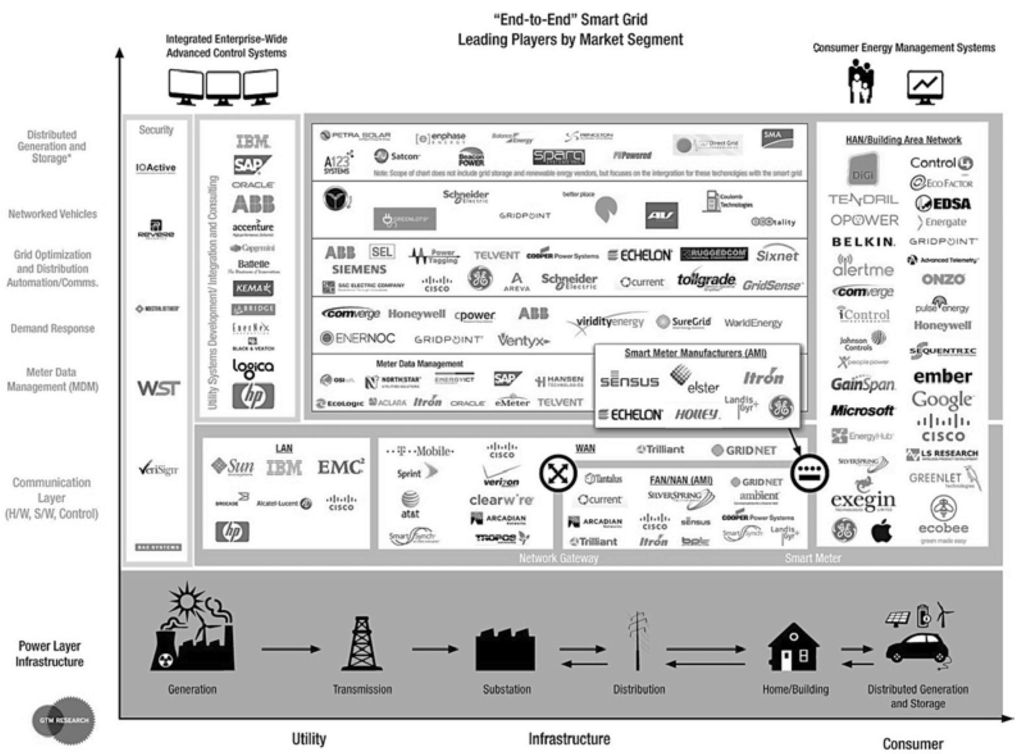
The definitions strongly imply that Smart Grids transcend the traditional boundaries of the energy production and transmission value chain. Monitoring, bi-directional data flows, machine-to-machine communication and electronics that enable automated optimization on system level are not in the capability domain of traditional utilities and transmission grid operators. A few years ago, Greentech Media Research developed a plot of smart infrastructure layers on top of the traditional infrastructure value chain (Fig. 3.2). While some companies represented in the figure no longer exist, have been acquired, or gone out of business, the structure reveals important features of the industry ecosystem.

While the incumbent energy value chain is represented in the familiar power infrastructure layer (bottom), Smart Grids necessitate the integration of a large number of other functional layers that build on top of the incumbent infrastructure. These include the communication infrastructure across which data is transmitted between the different stakeholders to the system; the meter data management layer; the demand response layer which exploits multi-source data to provide services for the optimized co-ordination of energy production and demand; the grid optimization layer which translates the data-based demand-response predictions into physical control of the system infrastructure; and the storage layer, which acts as a necessary buffer between peaks and troughs introduced by both volatile demand and renewable-based production of energy.

A closer look at the respective companies in the various layers of the Smart Grid ecosystem demonstrates that the structure of the system is highly cross-industrial

A closer look at the respective companies in the various layers of the Smart Grid ecosystem demonstrates that the structure of the system is highly cross-industrial. Indeed, it involves industry sectors and segments ranging from energy to telecommunications and software development; from machinery to industrial electronics and data analytics; and from computer hardware to home electronics and infrastructure construction. But how do these companies financially interact to form the ecosystem? What does the industrial skeleton – the value network – of the ecosystem look like?

Figure 3.2
Smart Grid industry layers



Source: GTM Research, 2011[14].

Data, software and IT are the beating heart of the Smart Grid ecosystem

Subjecting the ecosystem to the financial network mapping analysis reveals the monetary flows between the involved industries and subindustries, and shows the intricate industrial structure of the entire system (Fig. 3.3). It is important to note that the input data employed were selected at the very detailed six-digit GICS (Global Industry Classification System) level, well below the broad industry sectors. Hence, the network map reflects an integration of value chain data in the context of sub-sector groupings of industries with similar business activities. However, even if business activities are similar, their respective business models may diverge significantly.

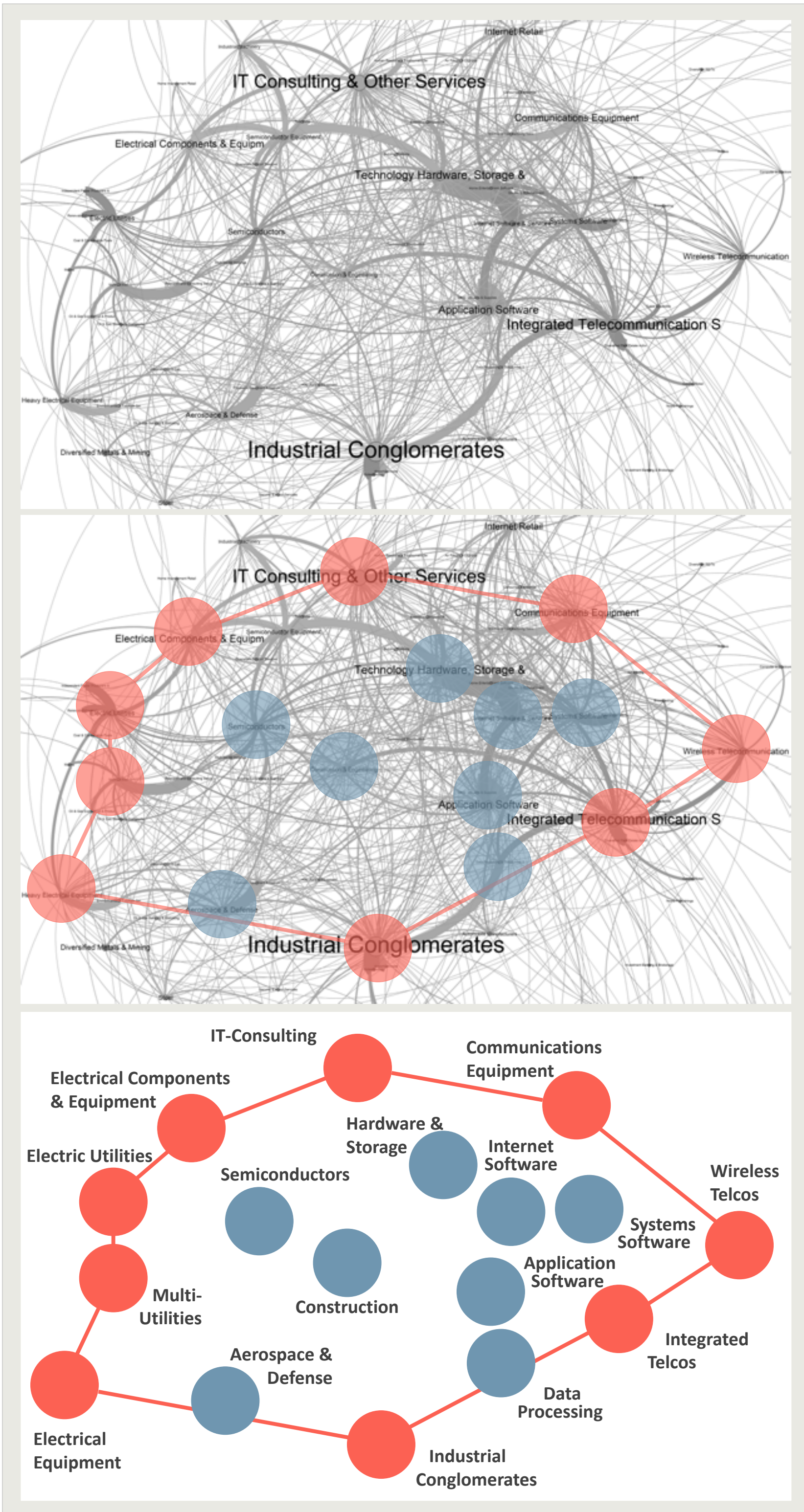
Starting with the top most panel of the figure, the edge thickness of connections between individual industry sectors denotes the relative financial exposure – i.e. the relative flows of money – between them. The thicker the edge, the more significant is the financial exposure – or trade relationship – between the industries. Another key dimension in the map is the positioning of the industries relative to each other. Those positioned closer to the core of the map display a higher connectivity, or network centrality, to all other industries than those located in the periphery of the map. The higher the centrality, the more "important" the respective industry is to the mutual connectivity of the entire ecosystem. Industries of high centrality bridge the chasms between sectors that otherwise would have very low connectivity in a given ecosystem. Aside from social networks[15], this observation has been made in financial networks as well.

Anchors are less well connected to the emerging ecosystem as they are still relatively contained in their incumbent industrial value chains

As displayed in the lower two panels, both more clearly presented abstractions of the original map, we use the centrality of nodes to distinguish between the roles single industries have in the financial network structure of the Smart Grid ecosystem. Industries of high centrality – encircled in light blue in the figure – are designated *catalysts*. They are built on the infrastructure of *anchor* industries – dark blue hexagons in the figure – that stake the perimeter of the ecosystem.

Anchors are less well connected to the emerging ecosystem as they are still relatively contained in their incumbent industrial value chains. However, they serve an extremely important role as the providers of capital-intensive infrastructure and vital technological components. Good examples of essential Smart Grid infrastructure are energy production facilities and transmission grids maintained by utilities and grid companies as well as the telecommunication networks maintained by both integrated and wireless telecommunication operators. Techno-

Figure 3.3
Smart Grid ecosystem



Maps by D. Assanis based on Bloomberg SPLC data.

logical components, in turn, are provided by electrical component and equipment manufacturers, industrial conglomerates, such as Siemens, Bosch and others, and communications equipment producers.

The role of catalyst industries, in turn, is the integration of the aforementioned industries to harness them for creating entirely new type of value that will be offered to users in the form of novel products and services. In the case of Smart Grid, this means increased efficiency, reliability and security through real-time, data-driven optimization technologies and services.

The role of catalyst industries is the integration of the aforementioned industries to harness them for creating entirely new type of value

One could argue that, in the case of Smart Grids, it is the catalyst industries that make the system intelligent – an Internet of Things (IoT). Catalyst industries include many software-based sectors such as systems software, application software and data processing. Semiconductors as well as technology hardware and storage further corroborate the centrality of IT-related solutions in tying together the intricate web of industrial activity in the Smart Grid ecosystem.

Smart Grid ecosystems display true industrial momentum

Our results confirm that a global, economically viable Smart Grid financial network is a reality. Power utilities, electrical and mechanical component and systems manufacturers, information and communication technology producers as well as telecommunications operators form a strong infrastructure layer that provides the physical foundation for the entire Smart Grid ecosystem. This foundation integrates power generation technology, transmission and distribution grids, the respective electronic and mechanical equipment as well as telecommunication grids and their control technology.

On top of the foundation, data and software -driven companies build scalable, fast growing businesses, leaning on the resources of the entire infrastructure layer. In doing so, cross-industrial value chains emerge and enable the creation of service models that add new value in the form of improved efficiency, reliability and flexibility. It is these companies that connect the involved legacy industries to form the emerging ecosystem and to make it "smart". IT-hardware developers, data storage companies, application and systems software developers, as well as data processing and analytics companies are in this growing nexus of the Smart Grid ecosystem. Machine-to-machine communication -enabled grid and facility automation, remote con-

Cross-industrial value chains emerge and enable the creation of service models that add new value in the form of improved efficiency, reliability and flexibility trolled smart homes and factories, micro-grid integration, demand response optimization, and predictive grid maintenance services are just few examples of new value added products and services powered by IT- and software-driven solutions.

Financial roundput is more intense among catalyst industries in the ecosystem

The multilateral structure allows for abundant roundput, distributing factors of production in the form of raw materials, components, systems, products and services across single industry boundaries. As the differences in edge thickness reveal, at least *financial* roundput is more intense among catalyst industries in the ecosystem, indicating a higher intensity in either activity, volume or both. This corroborates the importance of catalyst industries that seem to constitute the active core of the ecosystem.

As to the outstanding three defining principles of an ecosystem, the principle of diversity surely is satisfied in the case of Smart Grids as the ecosystem seems to feature both a multitude of diverse industries and plenty of redundancy in interaction amongst them. The diversity on the industry level is further reinforced by the diversity of companies within the individual industries that is not graphically represented in the map.

The principle of gradual change, in turn, is implicitly captured in the structure of the ecosystem as it is an emerging and changing ecosystem by definition. We all well know the structures of incumbent energy markets – pictured in the bottom layer of Fig. 3.2 – that have been exposed to changes via agile, digital service businesses to add intelligence to the legacy infrastructure. In fact, financial network maps are just the tool for uncovering gradual changes in the environment, especially when applied across time in a series of analyses.

The principle of locality is the only one that is less easy to apply to this particular context. As discussed earlier, local has to be understood not in a geographical sense but in an economic one and even there boundaries have become more and more permeable. Trade agreements between formerly separate economic areas have paved the way for unhindered flow of trade and resources across the globe. One of the most recent examples is the Comprehensive Economic and Trade Agreement (CETA) between the EU and Canada. On a closely related note, the map in Fig. 3.3 really is global. Yes, the initial set of companies that was used to start off the network analysis consisted of Finnish companies only, but as soon as the analysis was expanded beyond that set – to the clients and suppliers of the companies – no national restrictions were applied.

Financial network maps are just the tool for uncovering gradual changes in the environment

Telecommunication industries are better positioned to hop on the smart wagon

As an interesting final remark on the ecosystem's structure, the catalyst sectors seem to be more closely affiliated with telecommunications-related sectors than with energy utilities or component manufacturers. The close relationship is a tangible legacy of the internet era that witnessed the convergence of telecommunications providers, software developers, and data analytics services to create the still quickly evolving internet ecosystem.

These relatively close ties will put telecommunications providers in a more advantageous position to capture value in the Smart Grid space as they already form an important part of the respective ecosystem structure. One of their most valuable assets is an existing, proliferated and captive customer and payment interface that reaches every single individual with a phone or internet connection.

Close ties with catalysts will put telecommunications providers in a more advantageous position to capture value in the Smart Grid space

Telcommunications companies such as Nokia and Cisco have indeed engaged in strategic investments or acquisitions of home, local area, and geographic network and security companies to enable the roll out of new smart, digital services through their interface.

Case study 2: Smart Mobility – Increased safety, lower emissions, new jobs and improved social opportunities

Much in line with the evolution of Smart Grids, the emergence of the Smart Mobility ecosystem is driven by the various negative externalities that accompany the self-reinforcing, global megatrend of urbanization. The World Resources Institute (WRI)[16] claims that 70 percent of energy-related greenhouse gas emissions are produced in cities, and that developing cities, in particular, would contribute to the majority of traffic crashes that claim 1.2 million lives per year. The WRI explains that congested traffic costs the cities of Rio de Janeiro and São Paulo a combined $43 billion in 2013, a whopping 8 percent of the cities' GDP. The equivalent figure for Beijing, including costs related to air pollution, the Institute estimates at 7–15 percent of GDP. A study by the New Climate Economy[17], in turn, finds that Americans bear an extra cost of US$1 trillion related to urban sprawl.

To tackle these externalities, ICT-driven approaches to optimize available resources for moving people and goods in urban areas, in particular, provide for increased efficiency and safety "at a cost much lower than building new infrastructure from the ground up" (World Bank[18]).

According to the US Department of Transportation[19], Intelligent Transportation Systems (ITS) – the purely technological aspect of Smart Mobility – can be defined as "the application of advanced information and communications technology to surface transportation in order to achieve enhanced safety and mobility while reducing the environmental impact of transportation. The addition of wireless communications offers a powerful and transformative opportunity to establish transportation connectivity that further enables cooperative systems and dynamic data exchange using a broad range of advanced systems and technologies." The European Telecommunications Standards Institute[20], ETSI, adds that ITS include "telematics and all types of communications in vehicles, between vehicles (e.g. car-to-car), and between vehicles and fixed locations (e.g. car-to-infrastructure). However, ITS are not restricted to Road Transport – they also include the use of information and communication technologies (ICT) for rail, water and air transport, including navigation systems."

"Wireless communications offers a powerful and transformative opportunity to establish transportation connectivity that further enables cooperative systems and dynamic data exchange"

– US Department of Transportation

The benefits are said to be wide-ranging. The European Commission[21] claims that ITS "are vital to increase safety and tackle Europe's growing emission and congestion problems" and that "the integration of existing technologies can create new services, [supporting] jobs and growth in the transport sector." Tass International[22], a Dutch technology development organization for the mobility sector, explains that a connected, Smart Mobility infrastructure will enable the reduction of the number of traffic accidents as well as the reduction of emissions and fuel consumption while improving traffic flow. In addition to economic and environmental benefits, Smart Mobility will also entail social improvements by providing low-income population vastly improved access to urban job markets and educational systems. WRI[23] provides an example with Medellín's (Colombia) Metrocable system that "has transformed what was once a day-long journey from the city's mountainous slums to its urban core into a 30-minute affair, increasing access to daily needs and empowering the city's most disadvantaged communities."

Smart Mobility will also entail social improvements by providing low-income population vastly improved access to urban job markets and educational systems

But how do these lofty concepts translate into reality? Toyota Motor Corporation provides an insightful vision of Smart Mobility in a real-life setting (Fig. 3.4). Increased safety is enabled by real-time information sharing among vehicles, infrastructure and pedestrians. The information is used by automated collision prevention systems in vehicles to anticipate and actively avoid accidents. While sensor-based collision prevention systems already exist in contemporary vehicles, even more

Figure 3.4
Toyota's Smart Mobility vision

Source: Toyota.

effective solutions will be based on communication between vehicles and the surrounding urban infrastructure.

Increased comfort and ease of use is the result of advanced communication interfaces between the driver and her vehicle that include verbal interaction and predictive information sharing on suggested routing, nearby social events, shopping opportunities, car maintenance and other personal points of interest that the vehicles AI will tailor to the driver's individual profile.

Heightened convenience comes with the decoupling of ownership and availability of unrestricted transportation

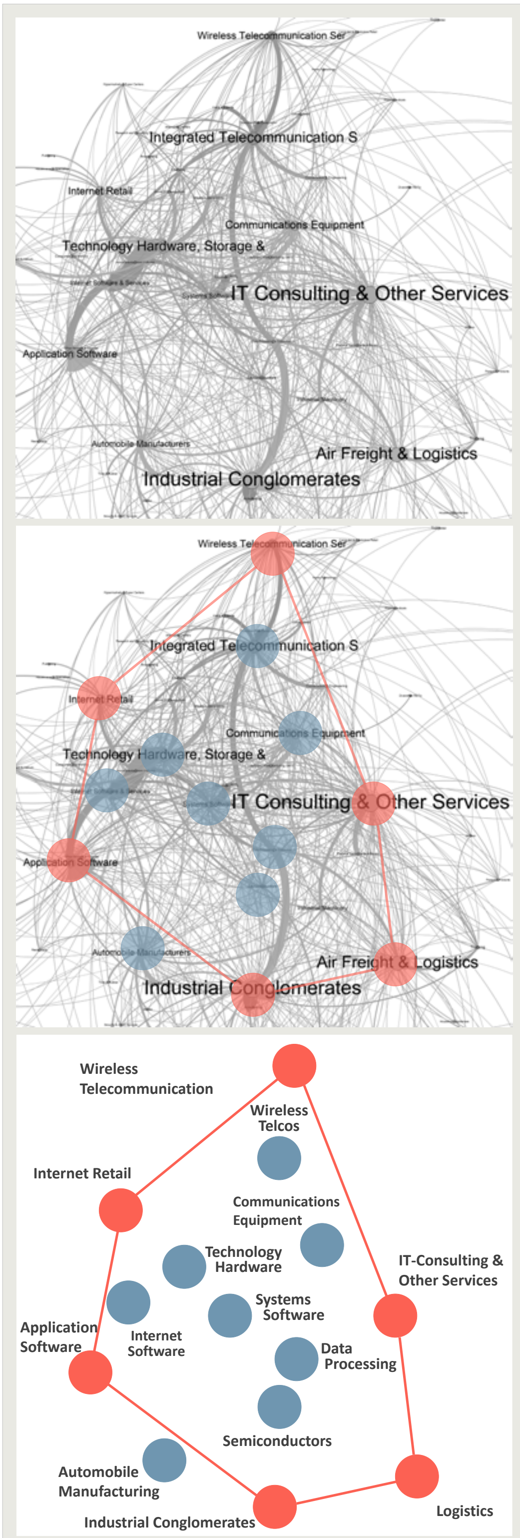
Heightened convenience comes with the decoupling of ownership and availability of unrestricted transportation. Interconnected public and crowd-sourced transportation (ride sharing, car sharing, etc.) systems are envisioned to render privately owned vehicles obsolete, as intelligent multimodal route guidance applications co-ordinate the availability and access to transportation services anywhere and at any time to anyone. The concept is also known as Mobility as a Service (MaaS). MaaS allows to forego heavy capital costs related to the ownership of cars and to incur only variable costs per use.

Finally, the progressing electrification of transportation systems has a direct impact on the ecological sustainability of traffic and other urban solutions. Electric vehicles not only reduce emissions in the direct urban environment but can be integrated into the larger Smart Grid ecosystem to serve as a temporary storage option for demand-response optimization purposes.

Smart Mobility already boasts an established industry structure

The network mapping analysis for Smart Mobility reveals established, cross-industrial value networks that speak of an ecosystem akin to Smart Grid (Fig. 3.5). Unsurprisingly, the anchor industry foundation features legacy industries that are both manufacturing and capital intensive. These include (i) wireless telecommunications as the provider of the necessary wireless and mobile data transfer infrastructure, (ii) the transportation industry (logistics) that commands ground, marine and aerial fleet assets to provide transportation services, (iii) internet retail as the sales platform and interface for purchasing mobility services in real-time on the go, (iv) the application software industry that develops mobile applications (e.g. route guides, navigation apps, and car sharing platforms) for users to navigate the interconnected mobility landscape, and technology component manufacturers, here "industrial conglomerates", as the providers of system components for the ecosystem's hardware infrastructure.

Figure 3.5
Smart Mobility industry ecosystem



Maps by D. Assanis based on Bloomberg SPLC data.

The catalyst industries, in turn, include the by now familiar software and IT-driven sectors such as systems software, data processing, and hardware, but now also feature sectors that in Smart Grid played the role of anchors. These are integrated telecommunications and communications equipment. It seems telecommunications operators are intent on leveraging their strong, direct link to consumers and established user interfaces to exploit opportunities in the mobility space. It is a brilliant strategy as Smart Mobility really is all about real-time information brokerage that, in contrast to Smart Grid, is easily delivered via mobile devices such as smart phones.

Smart Mobility is about real-time information brokerage that is easily delivered via mobile devices

The role of car manufacturing in the Smart Mobility ecosystem is still somewhat uncertain. According to Ford Motor Company's projections, about 80 percent of the total value of ground vehicles will reside outside the physical vehicle within a decade if car manufacturers do not take measures to integrate the added value of Smart Mobility-related solutions into the vehicles. Ford itself has declared to pursue a re-positioning strategy that will see a shift away from the drive train and chassis to the digital, interconnected dashboard as the most valuable element in a vehicle. Ford is on route to transform its identity from a car company towards a technology company. If Ford's case is to be taken as a signal of a trend that will define the future of car manufacturing, then the sector might very well serve the role of integrator in the budding Smart Mobility ecosystem. It might well become a catalyst sector, fighting for market share with telecommunications.

In summary we can state that there is clear evidence of industrial momentum in Smart Mobility.

Case study 3: Green Chemistry – A Bioeconomy sector in need of policy intervention

To conclude the chapter on ecosystem mapping by way of providing a contrasting case example to the two "smart" ecosystems, we take a look at a very different, yet equally prospective industry space: the Bioeconomy.

The last few years have witnessed an exponential growth in both political and commercial momentum for the concept of the Bioeconomy. The commitment to designing and supporting policies for the implementation of the concept runs high; institutions including national governments, the EU and the OECD have laid out long-term strategies to harness the progress in biological resource technologies for sustainable economic growth and improvements in physical and socio-economic welfare (see Box 3.1).

Box 3.1
Bioeconomy – A sample of definitions

"The bioeconomy comprises those parts of the economy that use renewable biological resources from land and sea – such as crops, forests, fish, animals and micro-organisms – to produce food, materials and energy. It is an essential alternative to the dangers and limitations of our current fossil-based economy and can be considered as the next wave in our economic development. It provides major opportunities for innovation, jobs and growth and as such will help to reindustrialise Europe."

Source: European Commission, Research & Innovation.

From a broad economic perspective, the bioeconomy refers to the set of economic activities relating to the invention, development, production and use of biological products and processes. […] The application of biotechnology to primary production, health and industry could result in an emerging "bioeconomy" where biotechnology contributes to a significant share of economic output. The bioeconomy in 2030 is likely to involve three elements: advanced knowledge of genes and complex cell processes, renewable biomass, and the integration of biotechnology applications across sectors.

Source: The Bioeconomy to 2030: designing a policy agenda. International Futures Programme, OECD.

Finnish economic developers have been at the forefront of strategy design and already have something to show for it. Only as recently as 2014 did Finland rank second in WWF's Global Cleantech Innovation Index[24]. Led by the Ministry for Employment and the Economy[25], Finland has crafted national Bioeconomy strategies which are to be implemented by national and regional development agencies via various technology programs, such as the new Bioeconomy Development and Growth Programme run by Tekes, the Finnish Funding Agency for Innovation. Efforts between agencies are effectively coordinated via the Team Finland consortium[26] that comprises central ministries and economic development agencies in the country.

Finnish government committed to promotion of Bioeconomy

The strongest of commitments, however, has been made by the Finnish government itself. In a push to turn around a lackluster economy, the government has declared the "Bioeconomy and clean solutions" one of its five strategic priorities (see Box 3.2). In the spirit of the various ex-

Box 3.2
Bioeconomy and clean solutions

1. Bioeconomy and clean solutions
2. Towards carbon-free, clean and renewable energy cost-efficiently
3. Wood on the move and new products from forests Breakthrough of a circular economy, getting waters into good condition
4. Finnish food production will be profitable, trade balance on the rise
5. Nature policy based on trust and fair means.

Source: Finnish Government[27].

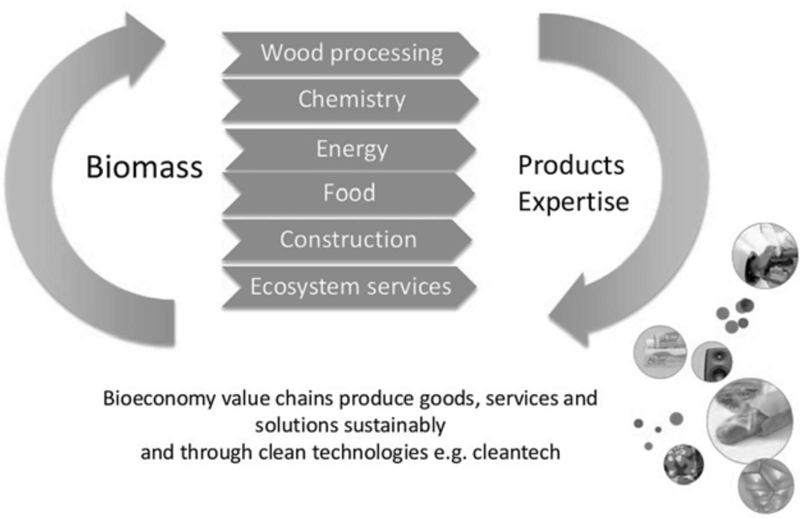
isting definitions of the Bioeconomy, the Finnish Government defines the concept very broadly, including economic sectors such as energy, forestry and paper, natural resource management, and food and feeds.

Figure 3.6 portrays the circular economy envisioned to constitute the industrial structure of the Bioeconomy. The strategy is broad and rests on the implicit assumption that the conventional industrial pillars of the Finnish industry will interconnect via new value chain segments and integrate innovations in biological materials to provide new economic value added in the form of sustainable products and process technologies.

The viability of the strategy, then, hinges on whether there is tangible evidence of new inter-industry value chains being formed. This evidence would suggest that industries and markets have picked up on the promises of the Bioeconomy and started to adapt to and build out bio-based processes. The question about industrial momentum is pivotal because creating an entire industry ecosystem from scratch – on political momentum and resources alone – is an extremely costly, inefficient and multi-generational undertaking.

Government policies indeed need to be designed by leveraging promising weak signals from the economy, to reasonably assure the viability of their outcome or impact. Given the long-lasting global excitement around concepts such as Cleantech and Finland's economic roots in natural resources and related expertise, it is easy to believe in a Finnish comparative advantage as grounds for industrial policy.

Figure 3.6
Bioeconomy value chains



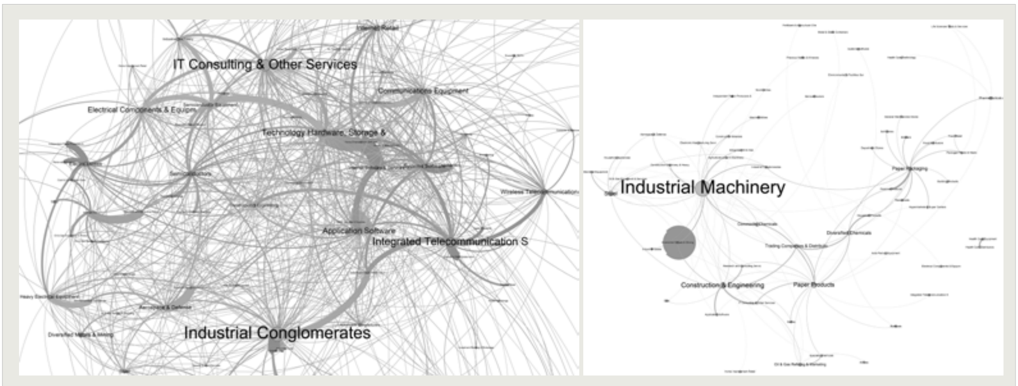
Source: TEM[28].

No transactional evidence of Bioeconomy on industry level

The evidence from economic data, however, is sobering. Company data[29] on inter-industry transactions reveal that the transactional connectivity, i.e. the existing value chain structure in the alleged Bioeconomy is weak at best (Fig. 3.7, right panel). There is no evidence of a (circular) value system structure that is envisioned in Figure 3.6. Compared with other inter-industrial Cleantech ecosystems – such as the well-es-

Figure 3.7

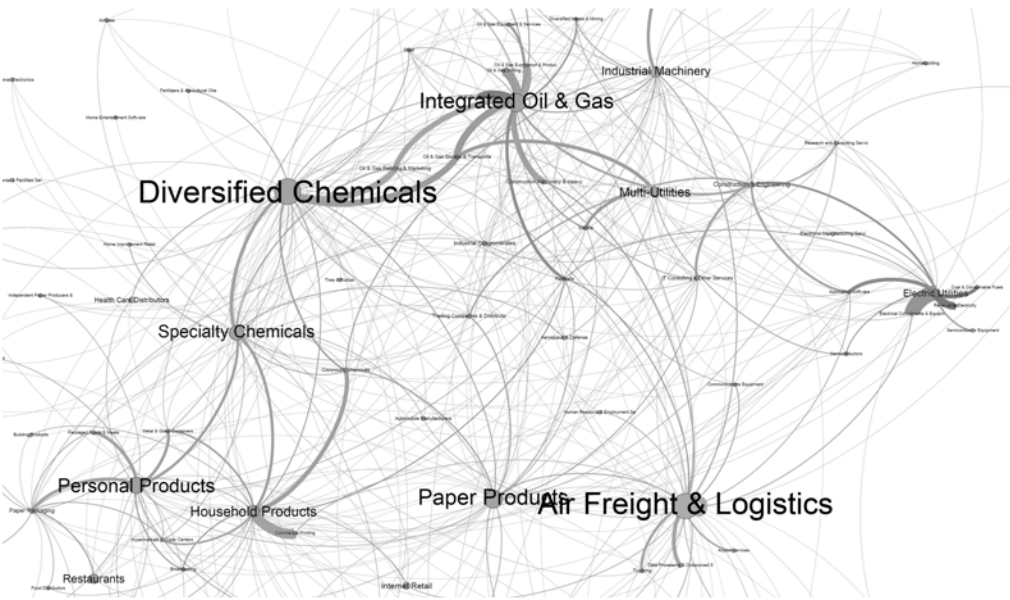
The robustness of value chain structures in comparison: Smart Grid vs. Bioeconomy



Maps by D. Assanis.

Figure 3.8

Green Chemistry value chains



Maps by D. Assanis.

tablished Smart Grid sector (Fig. 3.7, left panel) – the focal industry sectors of the Bioeconomy seem to remain transactionally isolated in their conventional legacy value chains.

What could be the problem? Maybe the all-encompassing bird's eye view on the entire Bioeconomy is too cursory an approach to reveal in-depth economic structures? One could ask whether evidence from economic actors in Bioeconomy sub-sectors provides more detail of their specific value chain relationships.

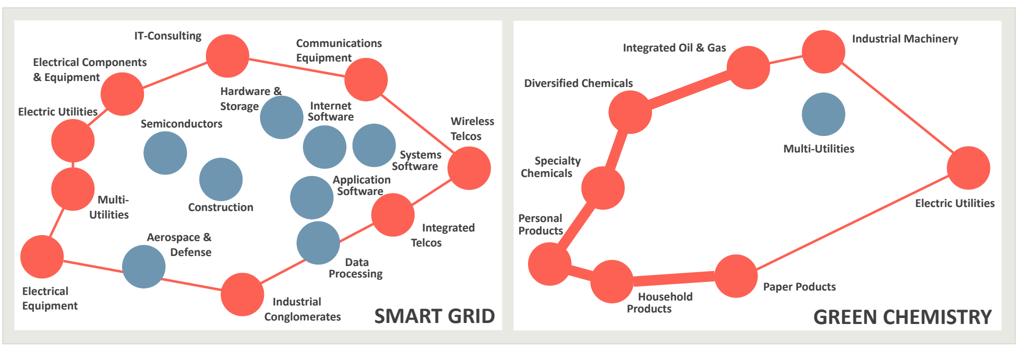
For instance, a look at Green Chemistry, an emerging industrial trend that seeks to substitute hazardous and fossil-based raw materials for sustainable and renewable resources such as biomass, provides for more promising results (Fig. 3.8). Robust transactional connectivity between a number of different industry sectors is clearly evident.

An abstraction of the same map (Fig. 3.9, right panel) reveals a multi-industry structure that encompasses sectors such as chemicals, integrated oil and gas, paper, household products, industrial machinery and electric utilities. Surely this should be strong enough empirical evidence of a circular economy? Unfortunately, this is a premature conclusion. Comparing the structures of the Green Chemistry ecosystem to those of the familiar benchmark, Smart Grid (Fig. 3.9, left panel), reveals decisive structural weaknesses in the Green Chemistry ecosystem.

Evidence shows weak signals of incipient Green Chemistry value chains

Unlike the Smart Grid ecosystem, the Green Chemistry ecosystem almost entirely lacks meaningful catalyst industry sectors. There are only few existing value chain structures between sectors that provide "green resources" – such as the biomass generating paper industry –

Figure 3.9
Abstractions of value chain structures in comparison: Smart Grid vs. Green Chemistry

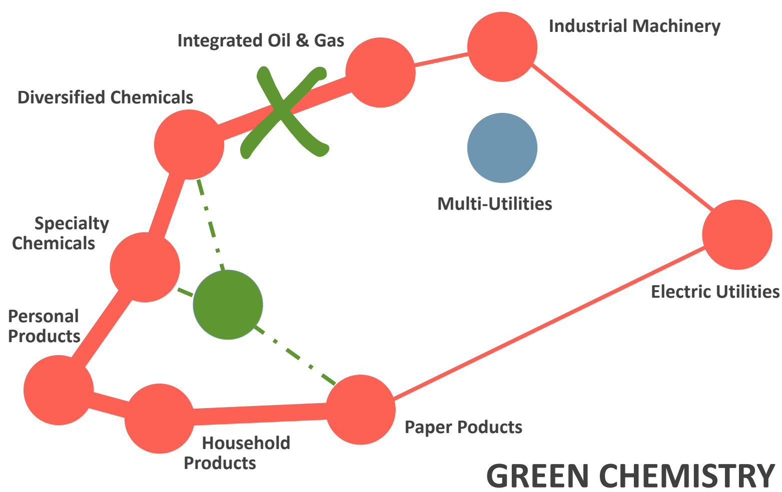


and industries that would use them as sustainable inputs. On the contrary, the structure displayed in Fig. 3.9 (right panel) represents the classical value chain structure of the chemical industry, consisting of its supplier relationships in the fossil raw materials industry, on the one hand, and its client relationships in the household product industry on the other. What we see in the picture is the industry's structure as it has existed for the past few decades already. In short, there is no indication of encouraging trends towards a new, biomass-based circular economy.

That being said, a detailed examination of the map displayed in Fig. 3.10 reveals that there are weak first signals of incipient connections between the paper and chemicals sectors. The three sectors are bridged by a potential catalyst, the commodity chemicals sector (Fig. 3.10, green edges). According to the data at hand, this link is still very weak but could be early indication of an alternative, sustainable, biomass-based resource sourcing strategy of the chemicals sector. Evidence that this signal is at work in the real stocks and flows of the economy is based on investments made by major chemical giants such as BASF and the Dow Chemical Company in entrepreneurial startups that have developed processes to generate new cellulose-based building blocks as input raw materials for chemical production.

There are weak first signals of incipient connections between the paper and chemicals sectors

Figure 3.10
Incipient value chains between paper and chemicals sectors



Promotion of Bioeconomy only viable as long-term, patient strategy with marginal short-term economic impact

What is to be made of the results? Clearly, the existing industrial structures do not promise short-term growth. The necessary circular value chain structures need to be developed first before the ecosystem can be expected to contribute to economic growth on any relevant scale. From emerging industry pilots in the Green Chemistry space – such as the number of rising bio-energy plants in Finland – we know that opportunities to harness the country's natural resources are seriously being probed. What is not known, however, is whether they will catalyze the much sought after economic growth.

Here, the crucial question is whether renewables-based materials merely substitute for petrochemical raw materials in the economic plumbing system of the conventional industry structure, on the one hand, or whether they actually entail the emergence of entirely new economic activity, perhaps even the emergence of entirely new industry sectors, on the other. If the former scenario turns out to be the case, the best possible outcome from an economic point of view is an increase in competitiveness – fueled by a global drive towards industrial sustainability – of the existing industry. It could provide fading, incumbent industry sectors with enough ammunition to stay in the game. This, of course, is an admirable outcome in and by itself, especially if it helps to sustain existing jobs.

The biggest threat to the emergence of robust links between biomass and chemicals are the vested interests between fossil raw materials and chemicals

For real economic growth, i.e. new industrial activity and job creation, however, only true industrial renewal is sufficient. The incipient structures between biomass-producing sectors and the chemicals industry could be a seedling of such activity. New companies are being formed that refine biomass into a form exploitable by the chemicals industry. The biggest threat to the emergence of more robust links between biomass producing sectors and chemicals are the long-lived, vested interests between the fossil raw materials sector and the chemicals industry. Evidence from Europe's largest chemical megacluster – the Antwerp-Ruhr-Rhein axis – is not encouraging. The strength and low cost supply of incumbent fossil fuel industries is at this time relegating bio-based materials to a niche substitute product, rather than displacing existing supply chains.

For an alternative, more sustainable structure to flourish and succeed, this strong link needs to be broken (see green cross in Fig. 3.10). This is a classic case for regulatory government intervention, justified by the environmentally negative externalities that entail the use of fossil raw materials.

In accordance with classical literature[30], one can argue that nurturing infant industries – such as Green Chemistry – is exactly what economic development policies are meant for. If such a strategy is chosen, however, the decision needs to be made with the awareness that, in case of the Bioeconomy in particular, it will not be a quick fix to an urgent problem such as the lackluster Finnish economy. Building an entire industrial ecosystem with its complex web of value chains is viable only as a patient long-term strategy that will far exceed the limits of any single term of office of any government. Beyond single pilots, there is currently limited market validation for industrial momentum in the alleged Bioeconomy.

Building an entire industrial ecosystem with its complex web of value chains is viable only as a patient long-term strategy

Leveraging the ecosystems approach for investment portfolio design

In this chapter we presented a data-driven approach to the identification and mapping of emergent industrial ecosystems. We did so because understanding and verifying the underlying industrial and business momentum in the target industries are crucial to the effectiveness and, ultimately, the success of thematic investing.

A theme in and by itself does not guarantee returns in any way; it is a necessary condition for calling investments thematic and achieving the respective impact. But financial returns are generated by leveraging investment capital into growing businesses. Therefore, the verification of industrial momentum in the chosen thematic industry space is the more stringent sufficient condition for generating sustained returns on invested capital. Our results on the lackluster Bioeconomy – even the more robust Green Chemistry ecosystem – are illustrative examples of thematic industry spaces that show small promise of swift returns that MARFs rely on for their success.

The verification of industrial momentum is the more stringent sufficient condition for generating sustained returns on invested capital

In the next chapter we show how the insights extracted from ecosystem maps are utilized to source a pool of candidate companies for portfolio design.

References

1 Tahvanainen, A.-J., Adriaens, P., Assanis, D. & Kotiranta, A. (2016). Growing Pains of Industrial Renewal – Case Nordic Cleantech. ETLA Reports (forthcoming). ETLA, Helsinki.

2 Schulze, E.-D., Beck, B. & Müller-Hohenstein, K. (2005). Plant Ecology. Berlin: Springer.

3 Odum, E. P. (1971). Fundamentals of ecology, third edition, Saunders New York.

4 Korhonen, J. (2001). Four ecosystem principles for an industrial ecosystem. Journal of Cleaner Production Vol. 9, pp. 253–259.

5 Pearce, D. & Turner, R. K. (1990). Economics of Natural Resources and the Environment. Johns Hopkins University Press.

6 Porter, M.E. (1998). Cluster and the new economics of competition. Harvard Business Review. Nov-Dec 1998.

7 Kotiranta, A., Kulvik, M., Maijanen, S., Tahvanainen, A.-J., Trieste, L., Turchetti, G. & Tähtinen, M. (2015). Raiders Of Lost Value. ETLA B267, Helsinki, Taloustieto Oy.

8 Porter, M.E. (1985). Competitive Advantage: Creating and Sustaining Superior Performance. New York.: Simon and Schuster.

9 Grandjean, M. (2014). "La connaissance est un réseau". Les Cahiers du Numérique 10 (3): 37–54. doi:10.3166/lcn.10.3.37-54. Retrieved 2014-10-15.

10 Bastian, M., Heymann, S. & Jacomy, M. (2009). Gephi: an open source software for exploring and manipulat-ing networks. International AAAI Conference on Weblogs and Social Media.

11 www.iec.ch/smartgrid/background/explained.htm (last access Oct 12, 2015).

12 ec.europa.eu/energy/en/topics/markets-and-consumers/smart-grids-and-meters (last access Oct 12, 2015).

13 www.smartgrid.gov/the_smart_grid/smart_grid.html (last access Oct 12, 2015).

14 GTM Research (2011). Available at http://www.greentechmedia.com/images/wysiwyg/research-blogs/HAN-Taxonomy.jpg (accessed 07052014).

15 Soramäki, K. & Cook, S. (2016). Network Theory and Financial Risk.

16 www.wri.org/blog/2015/01/who-needs-cars-smart-mobility-can-make-cities-sustainable (last access Jun 2, 2016).

17 newclimateeconomy.net/content/release-urban-sprawl-costs-us-economy-more-1-trillion-year (last access Jun 2, 2016).

18 blogs.worldbank.org/transport/smart-mobility-developing-cities (last access Jun 2, 2016).

19 www.its.dot.gov/standards_strategic_plan/ (last access Jun 2, 2016).

20 www.etsi.org/technologies-clusters/technologies/intelligent-transport (last access Jun 2, 2016).

21 ec.europa.eu/transport/themes/its/index_en.htm

22 www.tassinternational.com/safe-green-smart (last access Oct 22, 2015)

23 www.wri.org/blog/2015/01/who-needs-cars-smart-mobility-can-make-cities-sustainable (last access Jun 2, 2016).

24 awsassets.panda.org/downloads/wwf_report___global_cleantech_innovation_index_2014__final_.pdf

25 TEM (2014). Government Strategy to Promote Cleantech Business in Finland. Ministry of Employment and the Economy, Strategic Programme for the Cleantech Business. Helsinki, Finland. https://www.tem.fi/files/40668/Government_Strategy_to_Promote_Cleantech_Business_in_Finland.pdf (last access May 11, 2015).

26 team.finland.fi/en/team-finland-in-brief (last visited Jan 4, 2016).

27 valtioneuvosto.fi/hallitusohjelman-toteutus/biotalous (Last visited Jun 2, 2016).

28 TEM (2014). Sustainable growth from bioeconomy – The forest bioeconomy perspective. www.bioeconomy.fi, Ministry for Employment and the Economy (TEM), Finland (Last access Jun 2, 2016).

29 The Bloomberg SPLC Database.

30 Hamilton, A. (1790). Report on the Subject of Manufactures.

4

Company Assessment

Value Capture and Investment Grade as Qualitative Filters

Value Capture and Investment Grade as Qualitative Filters

> *We are in danger of valuing most highly those things we can measure most accurately, which means that we are often precisely wrong rather than approximately right.*
>
> – Sir John Banham,
> Director General of the Confederation of British Industry

Financial network maps are the basis for targeted company sourcing

As a first important financial technology component of the project, the financial network mapping tool constitutes an **efficient IT-based sourcing** mechanism for financially-related industry sectors and companies in new and emerging industries. The argument that the market dynamics can be harnessed by algorithms and models has its limitations in that the markets and course of economies are not modelable scientific phenomena. Rather, they are the result of mass human behavior and strategic corporate decisions, which are never predictable with any precision. Hence, important turning points in markets (buy-side) and industry responses (sell-side) are never identified with accuracy

Box 4.1
Industry classification codes

Industry classification codes are hierarchical numeric indicators, each of which represents a specific industry. With the increasing length of the code – experts speak of the *digit level* – the specificity and the level of detail of the industry description increases as well.

To provide an example, in the NACE (European Classification of Economic Activities) code system the code 20 – a *two-digit level* code – represents industrial activity in *Manufacture of chemicals and chemical products*. Adding numbers to the code improves the level of detail: 20.1 – a *three-digit level* code – narrows the activity down to the *Manufacture of basic chemicals, fertilizers and nitrogen compounds, plastics and synthetic rubber in primary forms*. Adding yet another number, say 20.1.2, gives us the *Manufacture of dyes and pigments*. Depending on the classification system and the purpose of use, the interested analyst can go as far as to consider eight- or even ten-digit levels. Our maps have been drawn on the six-digit-level.

Many different classification systems exist with most of them being used by national statistics agencies and global organizations such as the UN or OECD. These include International Standard Industrial Classification (ISIC), European Classification of Economic Activities (NACE), and North American Industry Classification System (NAICS). Some commercial systems exist as well. These include the Global Industry Classification Standard (GICS), which we use in this book for its compatibility with the Bloomberg SPLC database.

by experts and policymakers. However, this does not prevent temporal trends and financial structures from revealing themselves in time series of data that can be mapped as 'snapshots in time', for the purposes of deal sourcing. By integrating public company disclosures (lagging indicators), with data on venture and corporate strategic investments (leading indicators), emerging industry forecasting has probative value in support of models and maps.

Once the structure of an emerging industry ecosystem has been established, and anchor as well as catalyst industries have been identified using network theory principles, we are ready for company sourcing. As we learned in the previous chapter, the financial network map represents a relational database of financial transactions – or *exposure* – between companies that are representative of specific industry segments. It further indicates where the largest relative retention of value resides based on operational profit margins. As we will show shortly, this information can be harnessed to source potential companies for inclusion in the Multi-Asset Renewal Fund (MARF) portfolio.

A key objective of the fund is to pool capital allocations to private firms engaged in specific thematic areas and geographical areas. It is thus important to understand how companies in a region or country are represented in the network map, and to identify which segments of the industry ecosystem can be leveraged.

To accomplish this, we use the industry codes of the industry nodes obtained from the financial network map and search the respective country's company registry for representative firms active in these industries. Remember that, since the financial network map is cross-industrial, it would be very inefficient to source individual companies by reaching out to specific economic development regions. The corporate registry provides for a scalable sourcing mechanism of relevant companies. Even for a small country such as Finland, a database search in the Smart Grid, new mobility or Green Chemistry domains easily yields 1,000+ companies across all industries represented in a financial network map.

Prior to commencing company rating, it is necessary to perform a triage process. We need to boil down the vast number of companies to a manageable amount by applying a number of coarse filters. Negative selection criteria, resulting in removal from the target list, include the following:

1. Companies that are less than five years old AND show no revenue,
2. Companies that are no longer in business or have been acquired, and duplicates (e.g. doing business under a different name), and
3. Private subsidiaries of multinational or publicly traded firms

The rationale for this selection process is driven by our investment targets. The illiquid asset class is comprised of growth capital and unsecured debt, including illiquid credit and mezzanine debt. Companies that would qualify for this type of debt or equity investment would have to be post-revenue, experience market growth, may be engaged in internationalization strategies, and have received prior equity- or non-equity- investments. Given the already substantial availability of early stage equity investment capital in Finland provided by institutions such as Tekes, Tesi, and CleanTech Invest, as well as the availability of low cost debt to early stage firms served by Finnvera and Tekes, we decided that follow-on capital in the Finnish context was critical. Moreover, given the proof-of-concept stage of the MARF, it was deemed prudent to exclude pre-revenue companies with significant technology and business model risks.

Value capture and investment grade analyses assess Finnish companies in emerging industry ecosystems

Once the public and private companies are selected and triaged from the industry registry, the feasibility and long-term viability of companies to grow in emerging industries needs to be systematically evaluated. Specifically, we ask the following questions:

1 How are companies positioned in the ecosystem in terms of value capture?
2 What type of financing is most viable for the companies to improve their position and grow?

We employ a suite of proprietary, data-driven assessment tools, branded under KeyStone Compact®, and developed by Professors Peter Adriaens and Timothy Faley at the University of Michigan, Ross School of Business. The development work of the rating methodology is based on studies of over 600 companies and serial entrepreneurs in the US. In its commercial application by the Keystone Compact Group Ltd, the tools are used to empower entrepreneurs and economic developers with business model and investment risk insights that are typically domain knowledge of sophisticated investors and management consultants.

The specific use of KeyStone Compact® for company assessment and investment grade analyses is not exclusive. Most asset management service providers and portfolio advisors employ their own proprietary models to separate the wheat from the chaff. That being said, what matters more to the construction of a Multi-Asset Renewal Fund is that – irrespective of the particular model or tool employed – you are able to (i) identify investable companies out of the large triaged set of initial candidates, and (ii) structure a process to allocate these companies to the four asset classes in the MARF in accordance with their investment grade. KeyStone Compact® tools give us both of these functionalities.

The principle of the KeyStone Compact® suite of tools is to quantify tacit knowledge

The tool subjects companies to two analytical steps: Value capture analysis and investment grade analysis. The risk profiling and ratings methodologies employed by the KeyStone Compact® tools are based on publicly available, non-financial risk metrics for private and public companies, using a proprietary algorithmic approach. The output is a predictive analytical digest of the value capture potential and investment grade of a company given shifting industry structures, government policies, and broader market events or trends. We will explore these features shortly.

How does this compare to the big ratings agencies? Moody's, Standard & Poor's, Morningstar or Fitch use risk rating methodologies that employ fully disclosed algorithms to quantify qualitative and financial risk profiles of publicly traded companies. The risk rating is an outlook for a company or fund, driven by financials, government policies, and broader market events. It is primarily applied to public equities, corporate bonds, and various listed investment funds, and used to inform institutional and retail investors about the financial risk and return potential of their investments.

The KeyStone Compact® tool was originally conceived for emerging private companies. The developers sought to understand and codify what serial entrepreneurs had learned in the process of moving from company to company, and how they integrated that knowledge in the next venture. The output quantifies this tacit knowledge as a risk rating strategy. Let's make this more tangible by way of an example.

> Consider a mechanical engineer who joins a biotech startup as a product developer and focuses on design and testing of a new piece of hardware focused on detection of nanoparticles in complex fluids. Her knowledge is constrained to technical and performance evaluation issues of the product. She moves on to the next company as head of product development, and is responsible for supply chain management, materials and component sourcing. The knowledge, once steeped in hands-on product design, becomes more that of a systems integrator and resource manager. In the next startup she assumes a role as CEO or COO, and becomes responsible for company strategy or operations. However, because by now she understands the bottlenecks and workings in the industry, she leverages her know-how in product design and supply chain management into corporate strategy and tactics, or in organizing operational efficiency.

This information is cumulative, resulting in experience and what is often referred to as 'gut-feel' decisions. What if this information could be organized and codified for entrepreneurs, investors, economic developers, or business managers? That is the basis of the KeyStone Compact® suite, which has since expanded with versions for small & medium enterprises (SMEs) and large corporate entities. The basic tenets of the tools are the following:

1 The strength and investment grade of a company in a particular industry value system depends on the type of activity the company is engaged in.

2 The value capture position depends on how the company's capabilities and resources can be leveraged in the value chain, relative to competition, partners, and buyer/supplier networks.

3 The investment grade of a company – or the profitability of a new line of business (LOB) for a corporation – depends on (i) the upside potential to the investor in the case of private growth companies, and the upside potential of committed corporate debt or equity capital in the case of public corporations or large private enterprises, and (ii) the speed and capital efficiency at which the company or the LOB can be scaled. The investment grade is explicitly and quantitatively tied into the management- and supply chain-driven value capture metrics.

The analysis is based on two sets of 36 dichotomous (yes/no) -questions, the answers of which are algorithmically analyzed to produce a quantitative KeyStone Score® risk profile for a company, comparable to the Myers-Briggs personality test in its purpose. For those not familiar with this test, the Myers-Briggs personality typology is steeped in the theory of Carl Jung, and is structured around the two major attitudes or orientations of personality – extroversion and introversion, and four basic functions (thinking, feeling, sensing, and intuiting).

Table 4.1
Dimensions in the KeyStone Compact® business assessment model

Demographics: Value distribution for companies across activities in a value chain is industry-dependent	
Value Capture	**Investment Grade**
Assets: Physical and intellectual/intangible assets under the company's control	**Product**: The type of product, its supply chain, and market maturity affect profitability/scale considerations
Management: Background on founders, management and advisory board members	**Sources of Funding**: The sources of capital used to date indicate management, market and product risks
Structure and Partnerships: Corporate relationships necessary to bring the product/service to market	**Industry Segment**: The evolution of industry structure impacts product adoption and cost of goods
Type and External Drivers: Activity of the company and its dependence on policy and market drivers	**Marketing and Sales**: Comprehensive understanding of sales cycle, adoption rate, and revenue/cost structure
KeyStone Score®: Risk Rating Model for Emerging, Small, Medium, and Corporate Enterprises	

The test is often dismissed as not being scientific and thus not testable. That is not its purpose. It is based on observations of people. Decades of observations. It really only tells you how you are wired to take in and process data, not your actual skills and abilities. We live in a world of information. The more we accumulate, the more we have to process. All the time. Every day. And in the process we accumulate tacit knowledge. Knowledge informs opinions, perspectives, and decisions. Experiences influence how we project, market, and identify ourselves.

Tacit knowledge informs how business leaders process and project information, and make decisions for their company. Hence, a business assessment test based on codified tacit knowledge is a reasonable approach to measure investment, strategic and operational elements of a company and its management.

Let us consider value capture first. This analysis focuses on whether the company can capture and retain value from its business, given its position in the value system of the industry in which it seeks to innovate. The analysis focuses on mapping out the 'differentiation of the firm's own current capabilities' against the 'ease of acquisition of required complementary capabilities' from the firm's external environment, i.e. other companies and partners. The assessed capability dimensions include the company's tangible and intangible assets, the experience of both the management team and the advisory board, the structure of – and dependencies on – partnerships, and the firm's level of integration on a continuum ranging from the supply of components to being a systems integrator.

The risk rating profile for value capture is translated in a KeyStone Score®, that consists of four components: (i) ***Dependency*** on partners and third parties' capabilities; (ii) ***Leveragability***, i.e. the capability of a company to exploit its industry connections for promoting its offering and market access; (iii) ***Replicability*** of its core capabilities, both tangible and intangible; and (iv) ***Connectivity***, i.e. the quality of connections to the relevant industry and market segments.

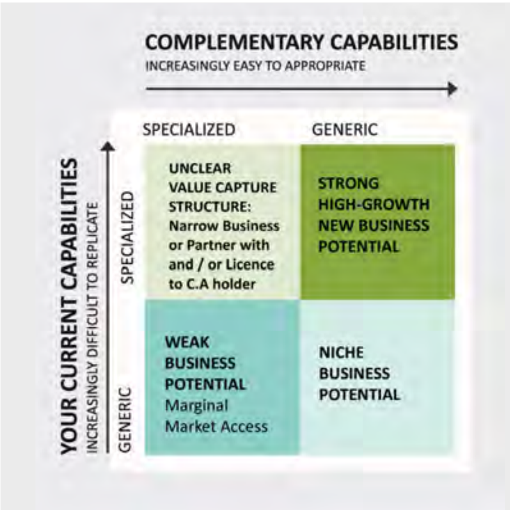
The scores translate into coordinates on the results matrix (see Figure 4.1). Companies are placed into four value capture quadrants: strong high-growth business potential, unclear value capture, niche business potential, and weak business potential.

1. Companies showing ***strong business potential*** command specialized and differentiated capabilities that mainly need generic complementary capabilities that are (relatively) easy to appropriate. These companies are expected to capture a lot of value from the ecosystem.

2 Companies with an ***unclear value capture structure*** are endowed with specialized assets that are difficult to replicate but require equally specialized complementary capabilities to be exploited. Capturing value from the ecosystem becomes a negotiated 'tug-of-war' strategy between the company and its partners.

3 Companies showing ***niche business potential*** have generic capabilities but only depend on easy-to-acquire complementary capabilities for their business operations. Because these companies cannot compete head-to-head with strongly positioned competitors, they need to identify niche markets that are far less competitive due to their smaller size to capture value.

Figure 4.1
Example of a relational network map



4 Finally, companies with ***weak business potential*** have very generic capabilities and need specialized complementary capabilities in order to productize their offering and deliver it to the customer. In this case, most of the value generated by the company is appropriated by its partners, which wield the needed specialized assets.

It should be noted that all analyses are snapshots in time, and are based on the current status of the firm. There is clearly a transition involved when the company pivots into different markets and industry value chains – a company's value capture position may very well shift over time. It is further important to point out that this positioning analysis is equally

Box 4.2
Interpreting Value Capture (DLRC) Scores

Elkamo Oy, a Smart Grid firm, shows the following computed KeyStone Score®:
7% **D**ependency; 40.6% **L**everagability; 93.3% **R**eplicability; 87.5% **C**onnectivity.

With marginal dependency on specialized complementary capabilities, high leverage of its resources towards buyers and suppliers, high differentiation in their industry segment, and excellent connectivity in the industry, this company will be algorithmically placed in the 'strong business potential' quadrant.

A query of the business model indicates some degree of vertical integration, serial entrepreneurs with prior experience in demand-side energy management, a software product that ties directly into energy supply enterprise software platforms, without external controls by energy companies or government policies.

relevant for startups and small and medium-sized enterprises (SMEs) seeking to reposition, as it is for large corporate enterprises considering to expand into new lines of business (LOB).

Investment grade analyses point to the most effective financial instruments to help companies grow

The positioning analysis provides an industry perspective on the company – akin to strategic analysis: It answers questions of where, how, and to what extent a company can exert and maintain its differentiated capabilities in a given industry or ecosystem? What strategy analysis fails to provide is an indication of the investment risk associated with this company. The subsequent investment grade analysis focuses on what type of capital – given their position for value capture – would be most efficiently deployed to build and scale a business. The analysis takes into account whether the scaling is achieved through market or capability adjacencies[a].

To achieve this analysis, the KeyStone Compact® assessment allows for mapping the 'upside potential' of the business against the 'time and capital required to scale' that potential. This results in a profile consisting of four investment grade indices: (i) ***Diversification*** of market and capability adjacencies, which indicates whether the company has identified alternative markets and parallel opportunities for its capabilities in the new ecosystem, (ii) ***Profitability*** in terms of explicit and implicit costs and margins, (iii) ***Scalability*** of the business model in terms of revenue generation and market access, and (iv) ***Capital Efficiency***, i.e. operational capital efficiency and the relative magnitude of additional capital necessary to drive continued growth.

The investment grade scores translate into coordinates that can be categorized into four matrix quadrants (Figure 4.2, left panel):

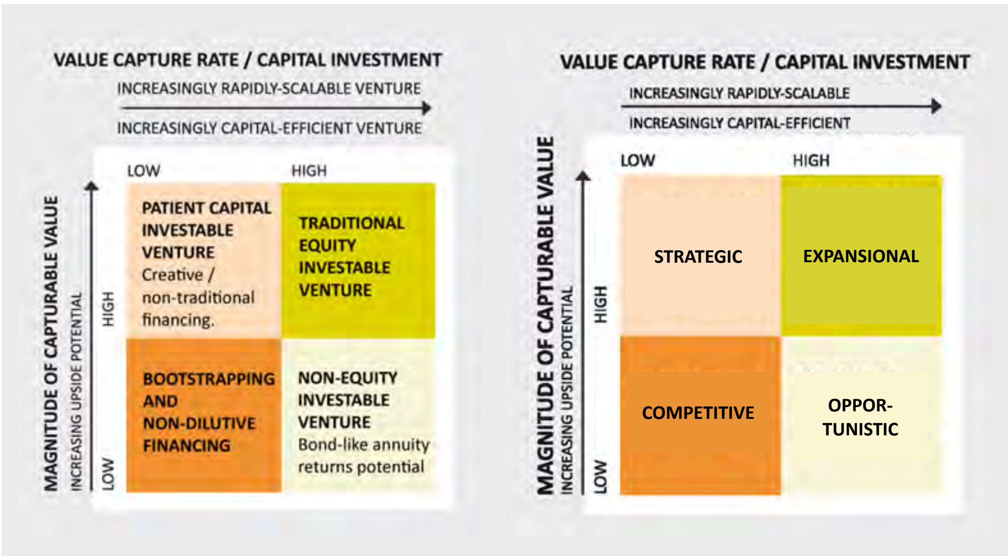
1 ***Traditional equity investable*** companies show potential for significant upside relative to the short investment time horizon, and a higher capital investment rate required to scale and grow the business. The rate is important because it indicates how quickly a company can capture market share, relative to the investment capital required. Capital efficiency is often bandied around in this context. However, it does not mean that a traditional equity investable company necessarily implies lower amounts of investment capital relative to other investments.

[a] A *market adjacency* is a market in which a company can sell a similar product or service. Typically, market adjacencies follow the adoption curve, from early adopters to 'the laggards' (Moore, 1991[1]). A *capability adjacency*, on the other hand, is a new market for a company that does not leverage its core capabilities. Thus, the company needs to develop (internally) or acquire (externally) products and/or services it currently does not have.

2 ***Patient capital investable*** companies are not traditionally equity investable, but can be financed using creative financing options such as mixed debt and minority equity, convertible notes, structured debt, and many other forms of investment. These financing options will involve some degree of equity in the company, either at the time of investment or in the future. Key is the longer investment horizon, and longer time to IRR (Internal Rate of Return).

3 The ***non-equity investable* firms**' upside value and time to scale position the investment as an attractive opportunity, but the size of the opportunity and investment required tend to make it unattractive to traditional equity investments. These firms have bond or annuity-like return potential based on their growing free cash flow.

Figure 4.2
Investment grade matrices



Box 4.3
Interpreting Investment Grade (DPSC) Scores

Coreorient Oy, Finnish Smart Mobility firm, has the following KeyStone Score®:
54.5% **D**iversification; 62.5% **P**rofitability; 64.3% **S**calability; 81.8% **C**apital Efficiency.

With a high opportunity for market diversification, attractive recurring revenue and capital efficient cost models, rapid product adoption rates, and economies of scale, this company was algorithmically placed in the 'traditional equity investment' quadrant.

The business model shows that the company sells through direct sales platforms, is heavily driven by data and service offerings, not subject to missionary sales, and has reinvested sales revenue in business growth. Its sales cycle is less than a month, and the industry is not regulated.

4 Finally, companies that are currently not attractive to external investors have neither a large upside potential, nor the ability to scale rapidly. Their risk and return profile matches ***bootstrapped*** or ***non-dilutive financing*** (grants, subsidized loans). Any of these companies can shift from their current position to a more attractive investment grade by way of strategic and tactical pivots in their business model.

Investment grade analysis allows corporate enterprises to assess the strategic viability of a new LOB in a changing business environment

How does the KeyStone Compact® assessment framework apply to large corporations? Lessons can be learned from the playbook of mergers and acquisitions (M&A) and corporate strategic investments. Large private enterprises differ from startups and most SMEs in that they are accessible only by large private equity (PE) firms and private lenders that offer acquisition financing, bridge loans, and recapitalizations intended to position companies for future growth. On the other hand, investments in large public enterprises are restricted to shares and bonds on financial markets, unless buyouts are considered.

Hence, the investment grade analysis in the case of large corporations is not applied to provide information on the *compatibility* of the business *with certain types of financing*, but rather to reveal *how attractive* the underlying *market opportunity* – here the Smart Grid space – is as a possible *new line of business (LOB)* for the company. In the case of an acquisition, the decision is typically based on product or market synergies between the buyer and the seller's offering, and ultimately a positive impact on the share price or other financial metrics, either by increasing market share or revenue enhancement from new LOBs in previously untapped markets.

Corporate investment grade analysis takes the view through a strategic investment lens

That being said, the same principles apply to the value capture and investment grade analysis, and the interpretation of the two dimensions that define the matrices. In the case of value capture, the complementary capabilities are those required to access a new market or build out a new LOB. In the investment grade analysis, the Y-axis denotes the *maximum upside potential* that companies can exploit given their current investment strategies, while the X axis measures *the speed* at which the potential can be exploited and scaled.

Using a similar approach to that described for the startups and SMEs, the algorithms place the opportunities as follows (Figure 4.3, *right panel*):

1 *An* ***expansional LOB*** places emphasis on the fact that the new business line allows for a substantial increase in market opportunities for the company. The added value and speed required to reposition may drive acquisition activity to acquire new capabilities and market access or substantial (re-)allocation of internal resources.

2 *A* ***strategic LOB*** tends to be more long-term and does not have the same urgency as the expansional opportunity. For the enterprise, there is substantial upside potential, impetus to (re-) allocate internal resources, and consideration to make investments in companies to help the corporation evaluate its options going forward.

3 *An* ***opportunistic LOB*** is a short-term investment opportunity in a currently more marginal activity such as those driven by policy shifts, project-specific demands, or a timely acquisition.

4 *Lastly, a* ***competitive LOB*** is essentially driven by wait-and-see industry competition to address the fear-of-missing-out (FOMO) phenomenon. The market opportunity is unclear and longer-termed, not warranting significant investments, but is affording a hedge position for the corporation.

Clearly, a number of assumptions are involved in both the cases of startup investments and corporate LOB development. However, the KeyStone Compact® tools allow for (i) a systematic interrogation of the opportunity resulting from the evolving industry ecosystem dynamics, and (ii) bringing to bear quantitative analyses for scenario testing. Conversely, the assessment allows for detailed understanding of business

Box 4.4
Interpreting Corporate Investment Grade Scores

CGI Suomi Oy, a Finnish transportation services firm, has the following computed investment grade score: Diversification, 100%; Profitability, 46.2%; Scalability, 31.3%, and Capital Efficiency, 57.1%.

These scores indicate high market diversification (platform business), fairly attractive revenue and cost models, but limited scalability in terms of market growth rate and capital efficiency. This company was algorithmically placed in the 'strategic opportunity' quadrant.

A deep dive in the business model and its applicability to new mobility services shows that the company is heavily dependent on market channels, subject to missionary sales. Its sales cycle is in the 3-month time frame, and the B2B service has limited control over its supply chain.

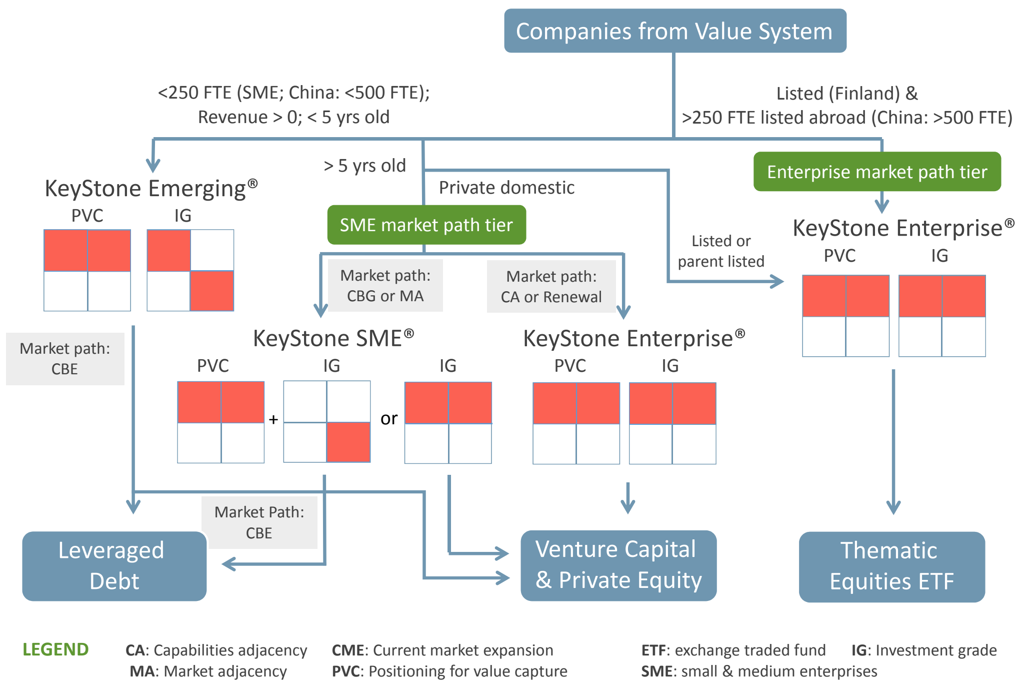
model adjustments to meet the scenario that best meets the strategic goals of the company and investment community.

The KeyStone Compact® typology triage platform informs asset allocation prioritization

The results of the KeyStone Compact® analysis can be used to (i) pinpoint investable companies in the fairly large mass of potential candidates as identified in the ecosystem mapping phase of the process, and (ii) rank them according to their investment grade into the respective asset classes of the MARF. The approach used is shown in Figure 4.3.

Akin to a decision tree in its principles, we call the approach an *investment typology triage platform* as it is a repeatable, three-tiered structure of consecutive filters: In a first filter, companies are sorted by size, age, and revenue. Size mainly refers to whether the company is classified as an SME or a large corporation based on full time employees (FTE). We refrain from using revenue numbers to sort companies, because this would limit the applicability of the tool in other markets than Finland or the EU due to availability of data. To qualify for the subsequent steps, companies need to be revenue-positive. The rationale for this criteria is that the complexity of multi-asset funds offered to large insti-

Figure 4.3
Investment typology triage platform for companies identified via ecosystem mapping



tutional investors necessitates limitation of high failure rates common in early stage companies with significant technology, management and market risk. In addition, there tend to be a range of other (low-cost) financing options available for this type of company, through Tekes, Finnvera, and other economic development funding.

The second filter considers the *market path* chosen by a company. The market path reflects the strategic decision made by the company on *how* it intends to leverage its current differentiation and position of strength for future growth. We consider four alternative paths:

1. ***Current business expansion (CBE).*** This refers to a company for which entry in the emerging industry value system is an expansion of its current market. No new technology or business models need to be developed. It is a matter of scale for a proven product and market, and hence the market risk tends to be marginal. Typical companies are those, for instance, that expand sales of new energy storage systems for residential applications from a city to an entire region.

2. ***Market adjacency (MA).*** In this strategic case, the emerging business opportunity is a new market a company can address using minor modifications of its technology, products, and processes. The company leverages its current infrastructure and know how to expand into new markets similar to its current market. The market risk to the company is incremental. Illustrative examples are companies that develop smart meters for home energy management market, and are expanding in the commercial building market.

3. ***Capability adjacency (CA).*** Exploiting capability adjacencies is a market strategy, the implementation of which requires the acquisition of new technologies and capabilities to address markets that are new to the firm. The company is still operating in the same industry, but the position in the value chain may have shifted, e.g. from design activities to manufacturing activities. Examples include companies that shift from producing geopositioning hardware to mapping features, a data-driven activity.

4. ***Renewal strategy.*** This strategic re-positioning is arguably the riskiest move for a company, because it needs to build out entirely new capabilities, supply chain partnerships, and product development processes in a new industry and market. The company can – to some extent – leverage management experience and other lessons learned from its prior markets and activities. Consider for example a company that shifts from a data services

company in telecommunications to becoming an energy arbitrage company in the Smart Grid industry.

The identification of the respective paths requires qualitative, company-specific due diligence. We need to ask for each company separately which of the paths reflects best the company's challenge if it seeks to re-position itself into a new ecosystem given its current capabilities and assets today. Most of the information required for the assessment is provided by the companies on their respective websites and other public forums.

Depending on the outcome of the market path filter – in the third step of the triage process – companies are then assessed with one of three KeyStone Compact® models: KeyStone Emerging® applies to young but revenue-positive companies that pursue a current business expansion strategy. KeyStone SME®, on the other hand, is tailored to companies that have been in business for a longer time, and pursue market expansion or market adjacency strategies. The KeyStone Enterprise® model applies both to SMEs that seek to capability adjacency or renewal strategies by leveraging existing LOB, on the one hand, and to large private or public companies, on the other. The questions applied and algorithms employed in the three versions of the tool are tailored to the specific circumstances faced by the various company types.

The triaging strategy shown in Figure 4.3 allows for further reduction of the pool of potential investment candidates. Companies that do not qualify for the quadrants highlighted in red will no longer be considered for inclusion in the MARF. Those that do will be allocated in the leveraged debt, equity investment and thematic equity investment asset classes of the MARF after a final non-financial and financial filtration process discussed in the next chapter.

Let us illustrate the discussed approach by way of three case studies: Smart Grid, Smart Mobility, and Green Chemistry.

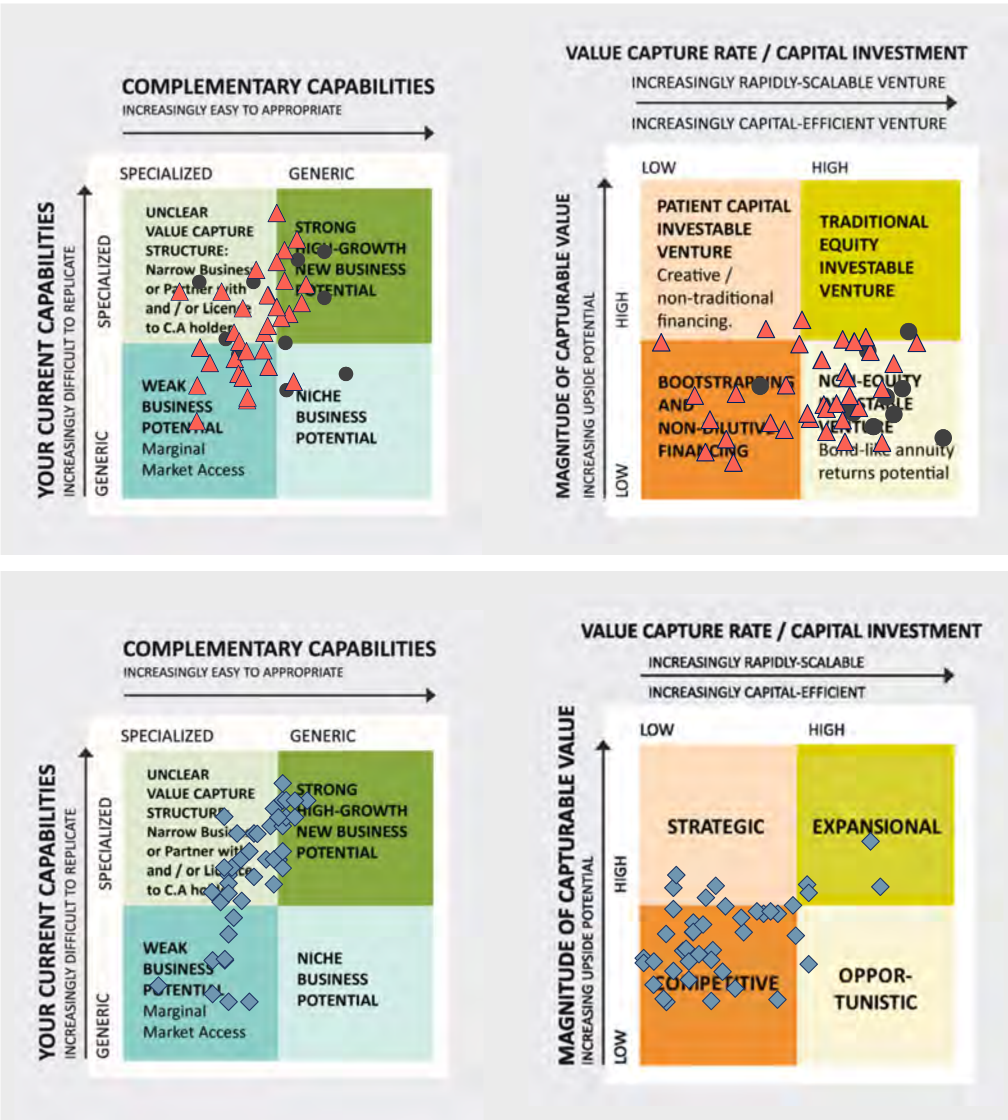
Case 1: Smart Grid – Value capture potential builds on low partnership dependencies and high differentiation of assets

Displayed in the left panel of Figure 4.4, the first stage gauges the strength of the position a company commands in a *specific industrial ecosystem*. The analysis rests on the fundamental assumption that a company's capability to capture most of the value it generates depends on the degree of control it asserts over relevant core assets vis-à-vis other stakeholders in the ecosystem. The less dependent a company is on specialized assets controlled by 3rd parties, the better is its capability to capture value from the ecosystem. It is important to note that the results are specific to the industry ecosystem where the company intends to compete. Pursuing multiple lines of business, more mature companies tend to operate in different ecosystems simultaneously. The results presented here are specific to the Smart Grid space.

A glance at the left panel of Figure 4.4 reveals that, overall, Finnish Smart Grid companies hold fairly strong positions in the ecosystem. As the distribution across the four quadrants shows, a very decent share of the 96 companies display either high-growth business potential or

Figure 4.4

Value capture (left) and investment grade (right) analysis for emerging businesses (grey), SMEs in business longer than 5 years (red), and large enterprises (blue) active in or positioning for Smart Grid LOBs



compete via beneficial partnering and licensing strategies. Differences between company types as defined by size are hard to discern, i.e. neither of the two company types consistently outperforms the other based on the KeyStone metrics. Large enterprises may have a predominance in the partnership segment, common to companies with complex supply chains and cross-border business activities.

The results presented in Figure 4.5 corroborate the visual observation: the four drivers that determine a company's value capture potential – dependency on third parties, leveragability of 3rd party assets, replicability of the company's capabilities and the connectivity of the company to the relevant ecosystem – do not show statistically significant[b] differences between startups, SMEs and large enterprises. That being said, the figure does provide insights as to which of the four drivers specifically contribute to the fairly strong positioning of Finnish Smart Grid companies. Two of them stand out in particular:

The first is a generally *low dependency* on third party assets. This implies that the companies exercise control over the relevant core assets – both *tangible assets* in the form of production facilities, information systems and infrastructure as well as *intangible assets* such as human capital, trademarks, and patents – needed to create their offering. The companies tend to be either highly integrated or serve as system integrators to generic component suppliers, in which case they have a broad enough choice of partners to avoid lock-in. In parallel, the dependency on strong partners for market access is similarly low, which helps to appropriate a larger share of value from end-user markets. The decent overall *connectivity* to the ecosystem, a separate driver of value capture in itself, further promotes the companies' freedom to operate in the emerging industry space.

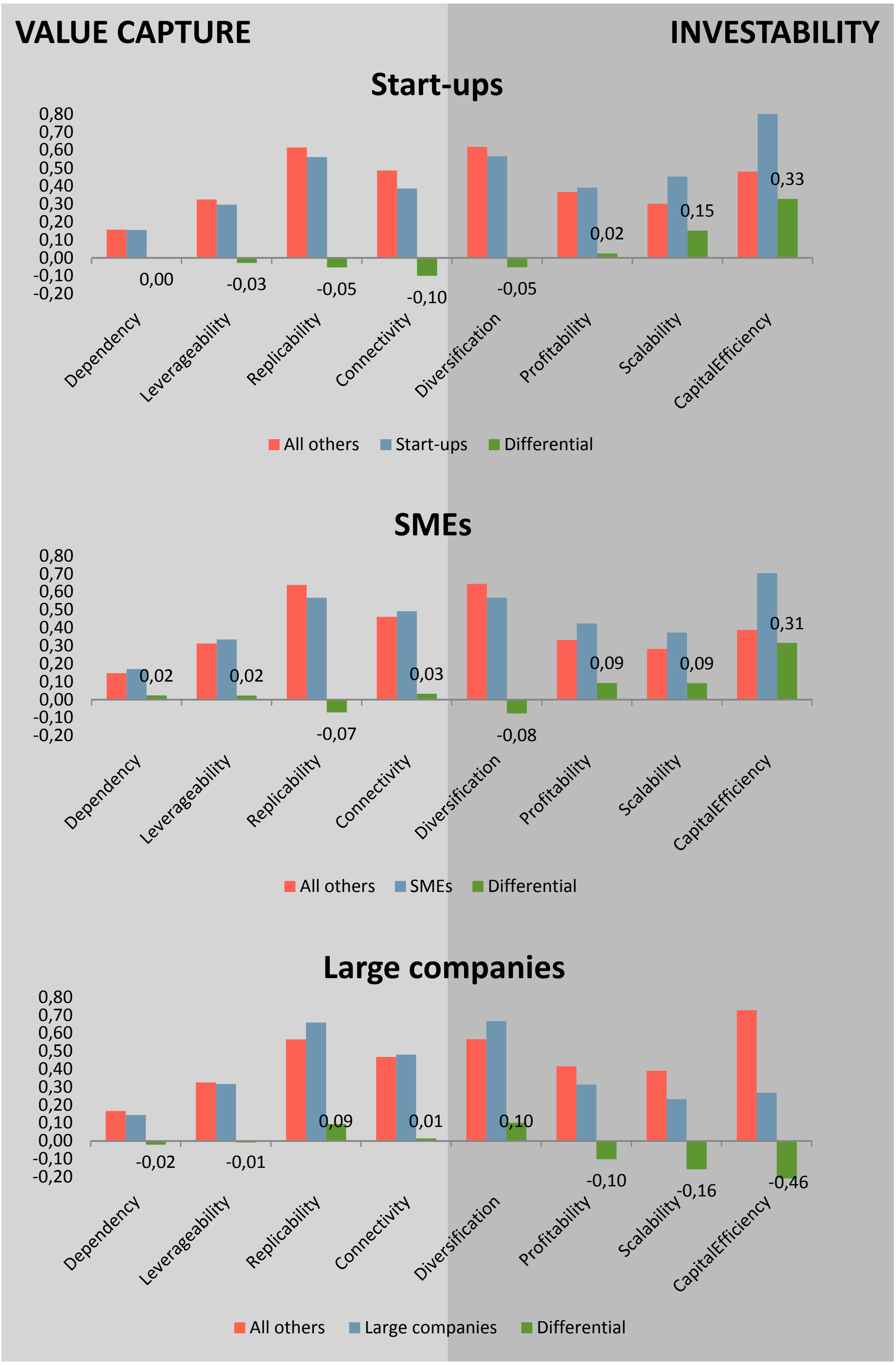
The second driver is the *difficulty* of competitors and partners *to replicate the companies' capabilities* in generating value. The positive results with regard to replicability speak of both strong intellectual property protection strategies as well as the presence of experienced and capable management teams that can leverage their accrued skills in navigating the emerging business ecosystem. This human capital is tacit in nature and therefore hard to copy or imitate.

Leveragability is the unfortunate chink in the armor

Of the four drivers presented in the left panel of Figure 4.5, *leveragability* clearly is the weak spot of Finnish Smart Grid companies. While *dependency* measures the strength of influence that external parties ex-

[b] The results shown in Fig. 4.4 are *t-tested* arithmetic averages of the respective Keystone Compact™ metrics.

Figure 4.5
Value capture and investment grade drivers of the Finnish Smart Grid sector by company type



ercise over a company, *leveragability* measures a company's ability to exploit its assets and partners to its own advantage. This includes the tangibility of core partnerships via contracts, joint ventures and other agreements but also the fierceness of the competitive environment and the degree of concentration in the industry, i.e. the market structure. Tough competition, an oligopolistic market structure and frail partnerships all gnaw at overall leveragability of company assets.

Tough competition, an oligopolistic market structure and frail partnerships all gnaw at overall leveragability

While the relatively weak *leveragability* does not seem to critically affect overall *value capture potential*, it has major indirect impact on the *investment grade* of the companies, as will be shown shortly. In particular, it has a strong inhibiting effect on the value that companies can normally reap from the diversification of their capabilities and markets.

Low expected profitability and the mediating effect of low leveragability negatively impact the firms' upside potential

The results for *investment grade* – see the right panel of Figure 4.4 – provide for striking insights. Across the board, irrespective of company type, the upside potential seems to be limited. Very few startups and SMEs show traditional equity investment grade. The great majority of companies finds itself in the lower two quadrants of the Keystone Compact® investment grade matrix. Supported by the results shown in the right panel of Figure 4.4, two main drivers can be identified for the phenomenon.

The first driver is a relatively low *expected profitability*[c]. The expected profitability of companies depends on a variety factors. These include the competitive structure of the targeted markets, their respective growth rates, the degree of commoditization of the companies' offering, expected margins typical for the targeted industry, the degree of separation from the end customer, the degree of recurrence in the revenue model and, finally, the degree of control over the sales channels.

Given these factors, what can companies do to improve their prospective profitability? Many of the listed factors relate to the competitive structures, growth rates and average profitability of the respective markets. These are factors that are in part external to the company and its sphere of influence. They represent market-driven systemic risks. There are two options that any company has when faced with unfavorable market conditions.

---

[c] For interpretation's sake, it is crucial to note at this point that profitability here is not measured based on past or current performance of the assessed companies. It is an approximation of the average performance of already established companies running a similar business model in the industry sector that the focal company strives to enter. One could say, profitability here reflects the potential upside that a given company can expect to tap into if the entry into the targeted ecosystem is successful.

The first is to ***seek out new markets*** with more favorable conditions for leverage and value capture. However, pivoting to new, less competitive and less concentrated markets with higher average profitability is a daunting task for any organization with a relatively fixed set of often market-specific skills and networks. To use a somewhat loose allegory for support, it is difficult for a lawyer to become a medical doctor because the required assets and skills are quite different and hard to adopt in a strategic move. Hence, companies will attempt to 'platformize' (see insert) their offerings to attract broader applicability and easier pivoting to new markets, even if this requires setting up new partnerships to access those markets.

The second option is to ***adapt business models***. This could encompass (a) new *value chain strategies* that emphasize gaining control over and shortening the relevant channels to the targeted markets, and (b) *re-designed business models* with a focus on creating multiple and recurring revenue streams.

New value chain strategies can take advantage of the progress made in digitalized technologies

Amongst many options, *new value chain strategies* can take advantage of the progress made in digitalized technologies, for instance, that help to move from physical distribution networks to generic online distribution platforms. These inherently have global reach and are not based on exclusive and captive distribution contracts.

As for *new business models*, moving from classic *make-and-sell* models to *anything-as-a-service (XaaS)* models – a manifestation of servitization – has been somewhat of a trend, which provides for recurrent sales revenues in conventional and emerging industries alike. A XaaS -approach brings particular benefits to manufacturing-driven businesses – such as component or sub-system manufacturers – that produce long-lived capital goods. In these businesses, re-sale cycles are long and, therefore, sales occur sporadically. A component-as-a-service model would provide for valuable customer lock-in effects and generate steady revenue streams, as well as benefit the capital efficiency of the operations. For the customers, on the other hand, the benefit is in not having to make expensive investments into capital goods that will pose a cap-

Box 4.5
Platform business strategy

This is a business model approach that creates value by facilitating exchanges between two or more consumers and producers. Successful platforms facilitate exchanges by reducing transaction costs and/or by enabling externalized innovation. As a byproduct, platforms also create ecosystems and leverage their inherent network effects. With the advent of connected technology, these ecosystems enable platforms to scale in ways that traditional businesses cannot.

ital risk to the liquidity of the business and have a major detrimental impact on key financial metrics such as Return on Capital Employed (ROCE).

The second driver behind the marginal upside potential (Figure 4.4, right panel) is the previously discussed inhibiting effect that the seemingly low *leveragability* of the companies has on the benefits they could reap from their otherwise high degree of market *diversification* (Fig. 4.5, right panel). Besides measuring the maturity of the industry – here Smart Grid – and the control that large enterprises have over it, the *diversification* metric indicates whether companies have identified opportunities to exploit their offering and capabilities on alternative, adjacent markets. These could serve as additional growth opportunities either by re-positioning the entire business or through additional lines of business. As asserted by the results, the companies in the Finnish Smart Grid industry fare reasonably well in this dimension.

A weak ability to leverage their strengths for growth is equally detrimental to business

However, their weak ability to *leverage* proprietary asset strength against other stakeholders – such as suppliers, customers, and competitors – in their industry ecosystem (Fig. 4.5, left panel), significantly hamper their opportunity to take advantage of valuable market diversification strategies. *Leverage* is the benevolent twin of malevolent *dependency*. Companies should avoid strong dependencies on partners to avoid being marginalized or commoditized, but a weak ability to leverage their strengths for growth is equally detrimental to business. Often, this is the result from competition on price, rather than on value. It is a deterrent to reaching maximum potential, which is captured in the weak results for investment grade in Figure 4.5 (right panel).

Large enterprises exhibit a very cautious approach to enter the Smart Grid space

A final, yet very telling, insight is that large enterprises fare particularly poorly in terms of how they view the Smart Grid opportunity. With few exceptions, the cluster of large enterprises with LOB's positioned for

Box 4.6
Elisa Oyj and Eltel Networks Oyj

Among all Finnish enterprises, these firms stand out for their expansional perspective on the Smart Grid opportunity. Providing network telecommunications integration, and smart network infrastructure, these companies have invested in platforms and partnerships to grow a new LOB in the Smart Grid industry ecosystem. Though other Finnish companies such as Nokia, Intstream, and Liaison Technologies (all in the data processing, monitoring and management industries) are active in the space as well, their engagement in the Smart Grid is more long-term.

Smart Grid locates mostly in the lower left quadrant of the Keystone Compact™ investment grade matrix (Figure 4.4). Hence, the Smart Grid opportunity is viewed as being either short-term 'opportunistic' or longer-term 'competitive'. In the case of eight companies, the Smart Grid market is viewed as being 'strategic' or 'expansional'.

As a brief review, the upper-right quadrant represents high-potential opportunities that enterprises can turn into value relatively quickly, using strategic acquisitions to acquire new market share, in-licensing and other expansional strategies. The upper-left quadrant represents high-potential opportunities that can be captured via long-term projects and strategic acquisitions to acquire new skills or technologies.

The lower right quadrant is the space of opportunities that will be pursued for more opportunistic reasons: the overall value of the opportunity may not be particularly high, but it is quick to exploit and will not require large investments, and are often internal ones. Finally, the lower left quadrant, the space in which most Finnish Smart Grid enterprises are positioned, defines prospects that do not show particularly high upside potential nor are quick to be exploited; the opportunities represent wait-and-see hedging opportunities and not explored for direct significant financial gain.

The companies' LOBs score extremely weakly in both scalability and capital efficiency

The obvious question is, why are Finnish large enterprises with activities in the Smart Grid space overly conservative? Is the reason capital resource conservation? Or risk aversion in an uncertain market environment? Perhaps they are cautious to sound out a new opportunity space, the economic prospects of which still remain somewhat vague?

A more tangible indication of possible causes is provided in Figure 4.5 (right panel). The companies' LOBs score extremely weakly in both *scalability* and *capital efficiency* when benchmarked against their smaller counterparts. Average *capital efficiency*, in particular, is extraordinarily low. These two drivers determine the speed at which any given opportunity can be exploited and scaled, and push the majority of enterprises into the lower left quadrant.

To extract insights from the findings, we need to break down the drivers in more detail. A low *scalability* score is indicative of a business model with long sales cycles and limited opportunity for value capture through diverse revenue models. In addition, the degree of synergy of the pursued business with the enterprise's other lines of business, the degree of commoditization of its products and services, the length of the typical sales cycle from sales lead to conversion, the ease of integrating the product or service into the customers' processes, the dependency on external sales channels, the maturity and concentration of the target market as well as the degree of regulation in the target market affect scalability.

Low *capital efficiency*, in turn, is driven by high investment requirements in physical assets for growing revenue streams, a focus on the production of physical products, low economies of scale in the production, and a low asset turnover rate typical for companies operating in the targeted industry segment.

Finnish enterprises are seemingly intent on entering the Smart Grid space with a choice of conventional strategies

In light of the findings we can then argue that Finnish enterprises are seemingly intent on entering the Smart Grid space with a choice of *conventional* strategies, relying on practices and models they know best from their legacy businesses: manufacturing-centric, capital intensive business models combined with slow-cycling sales models that are well suited for mature capital good markets, but are too sluggish and inflexible for capturing value in the fast growing, data- and analytics-driven smart layers of the emerging Smart Grid ecosystem.

Our earlier work[2] shows that manufacturing businesses are the clear center of gravity in the Finnish Cleantech space, even more so than in the domestic industry in general. In the gold rush era of digitalization, a heavily manufacturing- and engineering focused company base can quickly become the ball-and-chain to the mid-to-long-term growth of the industry. Hanging on to the legacy comes with the risk of being pushed to the proverbial periphery of the growing Smart Grid ecosystem. The ecosystem map in the previous chapter provides tangible evidence of this trend: Telcos as well as software and data analytics companies currently fight for dominance over the demand-response space, an area in which power utilities *could* reign superior given their control over the most central of physical assets, namely the power generation and transmission infrastructure.

A heavily manufacturing- and engineering focused company base can quickly become the ball-and-chain to the mid-to-long-term growth of the industry

The findings provide for valuable insights that we can use to design a strategic roadmap for the Finnish Smart Grid sector. Investors, company executives and economic developers can draw implications from the presented results. For a clearer focus on the Multi-Asset Renewal Fund and its design process, however, we defer to a detailed discussion of strategic roadmaps in the concluding chapter of the book.

Case study 2: Smart Mobility – Capital intensive business models anchor excellent value capture position of large companies

How well do Smart Mobility businesses fare in the value capture and investment grade analyses? Are they able to take advantage of the emerging opportunities in the ecosystem?

Contrasting the results of value capture and investment grade analyses of Smart Mobility to those from the Smart Grid industry provides for interesting insights (Figure 4.6). Unlike in the Smart Grid ecosystem, there seem to be fairly pronounced differences in value capture capabilities between large incumbent companies and their smaller competitors. Startups and SMEs are predominantly located in the weak value capture and unclear value capture quadrants typical for early ventures with limited structure and market access opportunities, as well as technology-heavy firms with significant supply-chain dependencies. Given that the KeyStone Compact® assessment is a snapshot in time, it indicates the relative immaturity of this sector.

Enterprises are clearly better positioned to exploit Smart Mobility opportunities

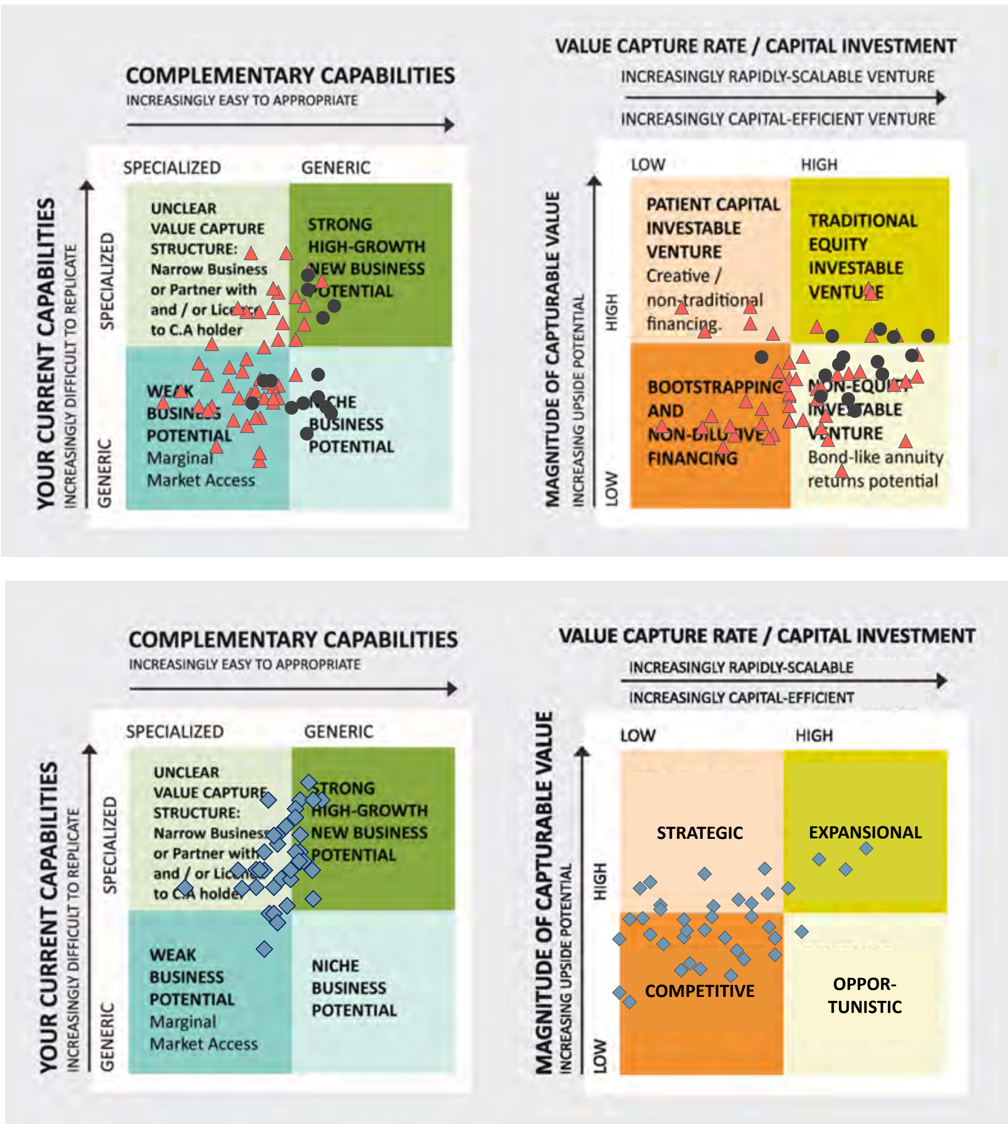
Enterprises are clearly better positioned to exploit Smart Mobility opportunities. The majority, if not all, of the assessed enterprises reside in the upper quadrants of the value capture matrix (*left* panel), indicating that they command over rather specialized, leveragable capabilities for the Smart Mobility business. Indeed, Figure 4.7 indicates that large companies beat their smaller peers in both the *difficulty to replicate* organizational core capabilities and industry *connectivity*. As discussed earlier, low replicability indicates strong intellectual property protection strategies as well as experienced and capable management teams that can bring to bear their skillsets in exploiting the emerging business ecosystem. This human capital is tacit in nature and therefore hard to imitate.

High *connectivity* to relevant industry partners, in turn, provides access to assets and capabilities *outside* the firm that it still needs for the production of goods and services in the new ecosystem. The exceptionally high connectivity – decisively higher than the connectivity of enterprises in the Smart Grid ecosystem – implies (i) *existing* partnerships in the form of contracts, joint ventures or other formal agreements and (ii) *capabilities to form new partnerships* via leveraging the management team's long-term experience in the relevant industry sectors as well as exploiting existing partnerships with third parties – such as consulting offices and economic development offices – that are well-connected in the new ecosystem.

The position of strength in the ecosystem is further corroborated by low *dependency* on third party connections. Companies seem to have abundant options with regard to partnerships and needed third party assets, which helps in retaining bargaining power and strong value capture capabilities.

The analyses reveal only one weakness that keeps large companies from populating the high-growth quadrant: *Low leveragability* of partnerships – the very same flaw that plagues companies in the Smart Grid

Figure 4.6
Value capture (left) and investment grade (right) analysis for emerging businesses (grey), SMEs in business longer than 5 years (red), and large enterprises (blue) active in or positioning for Smart Mobility LOBs



ecosystem – undermines the companies' ability to exploit their high connectivity for effective market penetration. The existing partnerships are not necessarily the most relevant for or most capable of providing market exposure. As is the case in the Smart Grid ecosystem, low leveragability might well be an indication of Smart Mobility's immaturity as an industry and market place rather than a sign of a weakness on the part of the companies. It is challenging to find channel partners to access a market if this is still developing or emerging. Once the market matures, however, their excellent connectivity and low dependency give large companies a formidable vantage point to exploit opportunities in Smart Mobility.

Investment grade of opportunities in the Smart Mobility ecosystem is poor

If the value capture position of large companies is convincing, the *investment grade* of opportunities in the Smart Mobility ecosystem is poor (Fig. 4.6, right panel). Large companies are found in the two left most quadrants of the investment grade matrix, indicating that the intended strategies to position themselves in the Smart Mobility space are more long-term. Fig. 4.7 (bottom panel) provides grounds for the interpretation, showing poor results for both the *scalability* and *capital efficiency* of applied business models. The companies suffer from the very same syndrome as their peers in the Smart Grid ecosystem: They enter the new ecosystem with *conventional* strategies, trusting approaches they have successfully employed in their legacy businesses. They are manufacturing-centric and their labor-intensive sales models incompatible with digitalized, autonomous service platforms that will capture most of the revenues in the growing smart layers of the emerging ecosystem. It is a pity especially because the results for *diversification*, an indicator for the volume of identified market opportunities, are extremely promising (81% average); even more promising than for enterprises in the Smart Grid ecosystem.

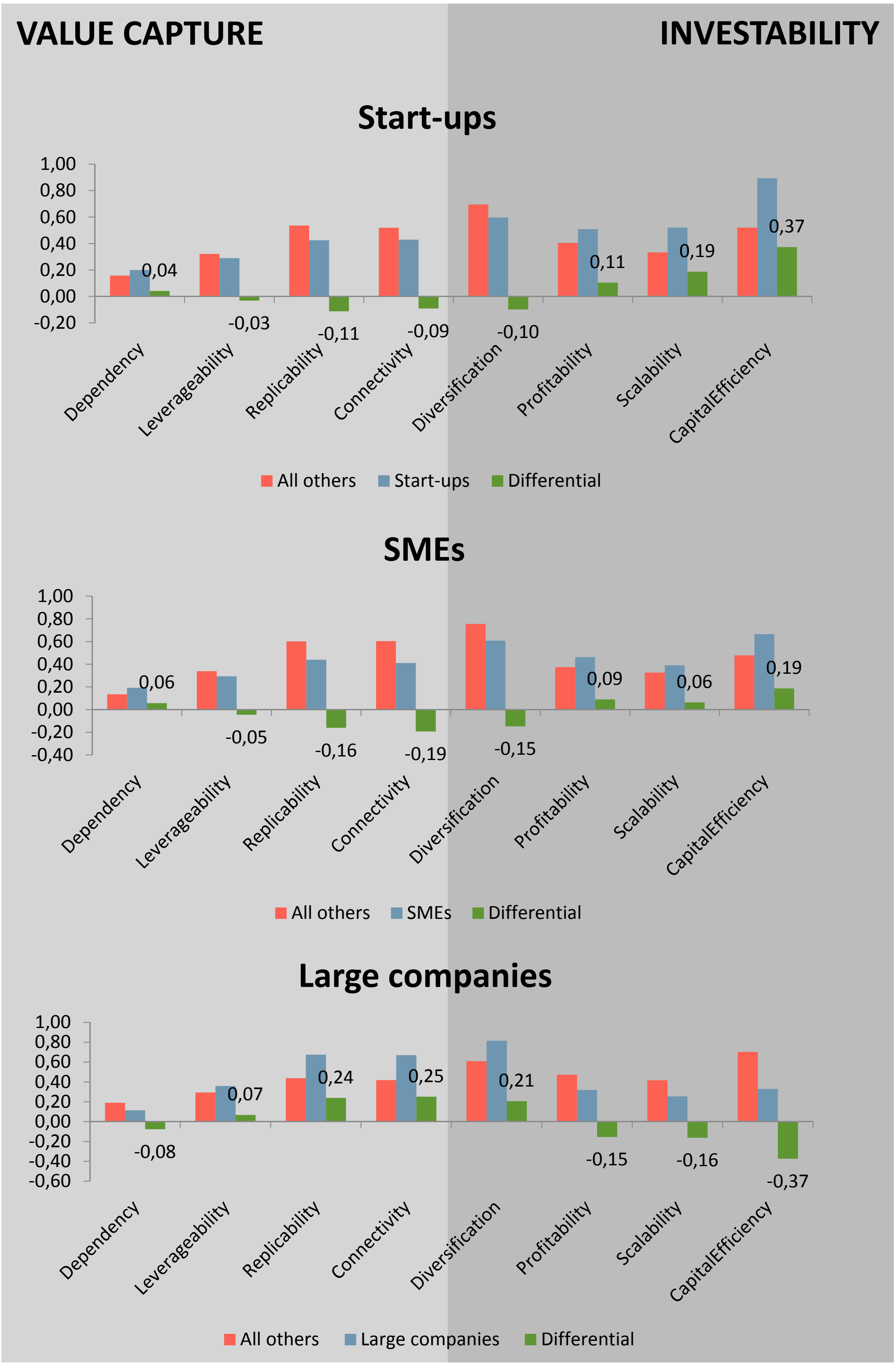
Smart Mobility startups and SMEs show weaker value capture capabilities but better investment grade than their Smart Grid peers

The value capture capabilities of Smart Mobility startups are, by and large, comparable to those of their peers in Smart Grid. While a small number of individual companies show promise of high growth and hold a strong value capture position in their respective value chains, many have to be content with niche business potential (Fig. 4.6, *left* panel).

Like their Smart Grid peers, Mobility startups have *poor leverage* over their market channel partners. An additional weakness is relatively *high replicability*. At 42 percent, their *average* Keystone score for the diffi-

Figure 4.7

Value capture and investment grade drivers of the Finnish Smart Mobility sector. The bars represent averages for the respective KeyStone Compact® metrics for each size class.



culty to replicate key value capture capabilities is 14 percentage points lower than in the case of their Smart Grid benchmark (Fig. 4.7, upper left panel). The threat of imitation and the ease of acquiring the same assets the companies employ to generate value compromises the amount of value Smart Mobility startups can retain. Small and medium-sized companies fare even worse. Not only is their average *replicability* score much lower than that of Smart Grid SMEs, but their performance is weaker with regard to almost every other value capture metric with the exception of *dependency*. *Connectivity*, especially, is weaker by eight percentage points.

Smart Mobility startups and SMEs show goodperformance in terms of investability

In contrast, Smart Mobility startups and SMEs show better performance in terms of *investment grade* than their peers in the Smart Grid ecosystem (Fig. 4.7, *right* panel). Startups, in particular, outshine the benchmark in every *investment grade* metric. With an impressive average *capital efficiency* score of 89 percent, a *diversification* score of 60 percent and both remaining metrics above 50 percent, the *average* Smart Mobility startup would be a clear candidate for high-growth equity investment.

The companies have identified both abundant and lucrative market opportunities (high *diversification* and *profitability* scores), and have developed the right business models to quickly access and exploit them (high *capital efficiency* and *scalability* scores). The question is what is stopping them? Why do we not see most of the companies pictured in the upper right corner of the investment grade matrix?

As was the case in Smart Grid, the culprit is the companies' poor value capture position in the ecosystem. A weak position affects the ability to retain created value and, thereby, has a strongly compromising effect on the upside potential a company can tap into. In a poor value capture position much of the potential is captured by partners and the competition. Investors and financial markets take this into account and correct the investment grade assessments accordingly. Compared to startups, SMEs suffer additionally because they seem to employ less scalable and, ultimately, also less profitable business models. Scalability and profitability have an effect on both the upside potential of a business and the speed at which returns can be generated.

A weak position affects the ability to retain created value

Case study 3: Green Chemistry – A biotechnology industry model where innovators partner with incumbents for channels and capital

For contrast's sake, let us take a look at a final example: Green Chemistry. The Green Chemistry industry in this case is defined as a subset of the Bioeconomy as introduced in the previous chapter. The rationale is that the Bioeconomy is defined in Finnish strategic government reports as any component of the economy that uses or generates biomass-related products or services. Hence, it encompasses agriculture, forestry, water treatment, construction, biofuels and biodigestion, and the food industry. As we noted in the previous chapter, these are – from an industry structure perspective – unrelated segments of the economy. Hence, we decided to focus on Green Chemistry, an industry that is generally understood to mean "*the design of products and processes that minimize the use and generation of hazardous substances*". Perhaps the most challenging aspect of assessing the Green Chemistry industry is that Green Chemistry is less a description of a discrete industrial segment than it is a way of carrying out industrial activity, from design to manufacturing.

"The bio-based segment of the market excluding biofuels is liable to grow slowly"

– Pike Research

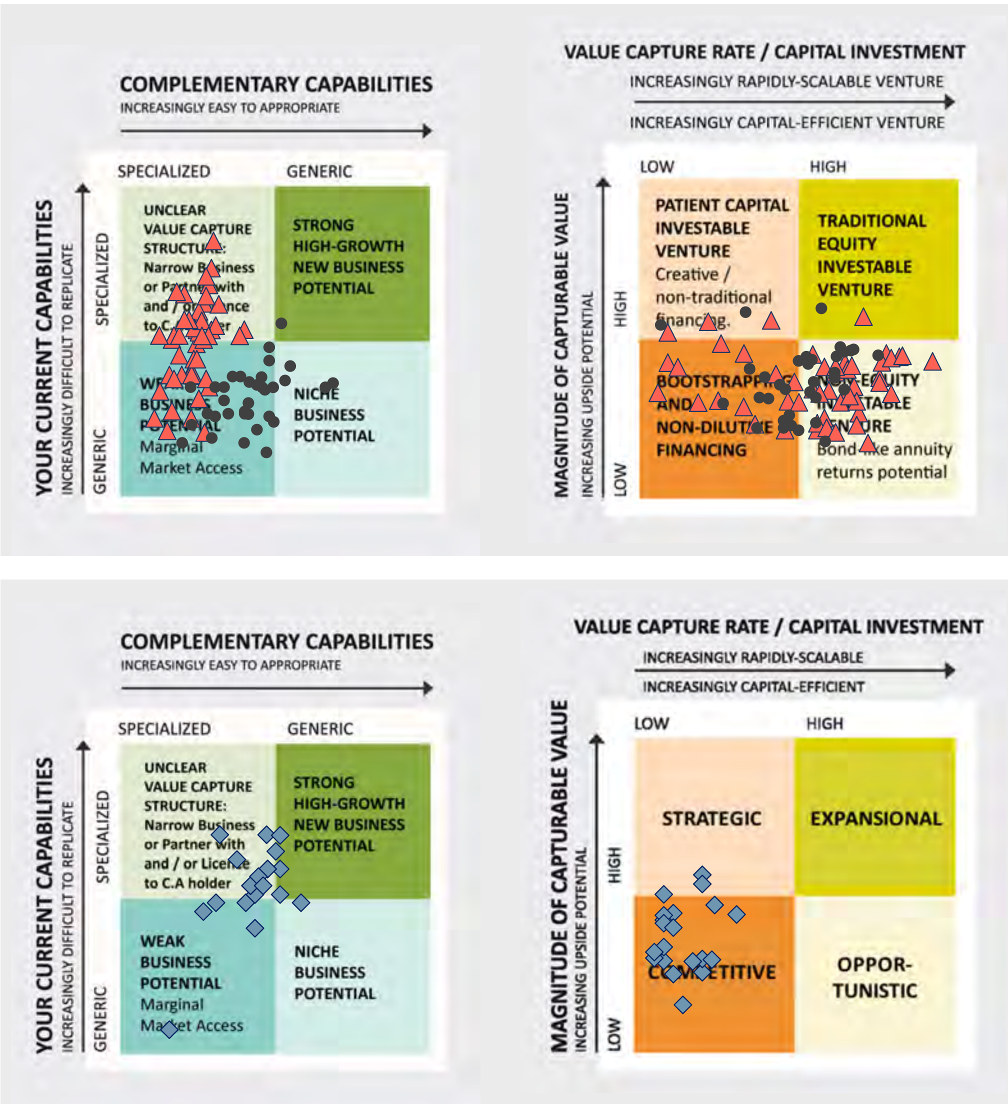
According to Pike Research[3], Green chemical industry players run the gamut from vast multinationals that have been in operation for over a century to tiny startups. Much of the bio-based segment, which perhaps has the greatest long-term potential to revolutionize the chemical industry, is nascent. Technologies are just a few steps beyond the laboratory, and production facilities are a few years from reaching their modest full production levels. The bio-based segment of the market excluding biofuels is liable to grow slowly because of challenges with issues of scale. Also, in the chemicals and materials business, the adoption cycle often requires long lags for extensive customer testing before new products are introduced."

We thus explored the companies and industry sectors that participate in the value chains of the various activities geared towards building out the material sourcing, chemical manufacturing, sales and integration into consumer products. A total of 61 companies, from a registry base of over 100 companies, was analyzed for value capture and investment grade (Figure 4.8).

The results indicate that, as compared to Smart Grid and Smart Mobility, most startups and SMEs occupy the 'weak business potential' quadrant, some exceptions notwithstanding. This could plausibly be attributed to the immature markets in this space. Without external policy drivers incentivizing the integration of green chemistries, and without internal efficiency drivers in the industry (see the previous chapter), the opportunities for new market access are limited, except through partnerships with large enterprises. This segment of the economy fares better in the value capture space, with most companies in the partnership and license area, only straddling new growth potential.

In the investment grade analysis, the business and revenue models of 90% of startups and SMEs places them in the lower two quadrants, with the overwhelming majority in the debt financeable quadrant. The implication is that it can be expected that cash-flow driven businesses will be built, rather than high growth platform firms with significant

Figure 4.8
Value capture (left) and investment grade (right) analysis for emerging businesses (grey), SMEs in business longer than 5 years (red), and large enterprises (blue) active in or positioning for Green Chemistry LOBs



market and revenue diversification opportunities. The large enterprises fare no better: Close to none of the analyzed companies are currently engaged – or have committed resources to – the Green Chemistry industry.

High dependency, low leveragability, and poor scalability explain the generally weak investment grade positioning of all three company sizes

As is the case with many nascent markets, the green chemical market is expected to grow through several stages: a profusion of small companies based on exciting technologies will gradually coalesce, through failures, acquisitions, and mergers, into a functioning ecosystem. Many of these small companies will likely choose to follow a model that is common in the biotechnology industry, whereby small, innovative companies partner with industry incumbents to obtain capital and distribution channels. Established companies have the luxury of choice. They can either establish their own green operations, or watch the startups as they develop and acquire those that are the best fit for their own businesses once some of the technology and market risk has been wrung out.

The results indicate that the technical advantage of startups and SMEs cannot be effectively leveraged in an industry where most large players are very diversified and tend to be dominated by fossil fuel raw materials. This was borne out in the Green Chemistry ecosystem, as presented in Chapter 3, as well. Most financial transactions occur between the oil companies and refiners on the one hand, and specialty/diversified chemicals on the other hand, to supply the various consumer goods industries. These include personal care and cleaning products, baby products, apparel and footwear, healthcare, electronics, building materials and furnishings. According to a recent report from TruCost[4], enhanced value chain collaborations are required to accelerate safer chemistry. This points to the immature linkages, as we saw in the financial network map earlier, one-project-at-a-time market development, and thus lack of leverage for startups and SMEs.

What about the large enterprises? Why are they characterized by limited leverage, high dependencies and low scalability?

The uncertainty of green policies and volatile petroleum prices are to blame. While regulatory regimes at the federal level in the United States do not appear likely to become increasingly stringent soon, several states have imposed strict new regulations on hazardous chemicals, as has the European Union, by way of promulgation of the REACH (Registration, Evaluation, Authorization and Restriction of Chemicals) program. Enacted in 2007, it has been phased in over the next ten years, and aims to improve the protection of human health and the environment through the better and earlier identification of the intrinsic properties of chemical substances, particularly when better alternatives are available. The phase in has been slow and the industry response is largely voluntary[5].

On the other hand, consumers are becoming increasingly aware of the potential effects of the chemicals used to produce common materials and are demanding green alternatives. Companies are being forced to meet not only end-user demand, but also the demands of powerful retailers, which can dictate product specifications to their suppliers by virtue of their vast sales. But the low petroleum prices – crucial both as a source of process energy and as a feedstock for many chemical processes – have slowed down scaling of and investment in finding alternative, renewable feedstocks for key chemical products and intermediates.

Green Chemistry startups and SMEs show strong differentiation and connectivity in the industry

Despite these mixed market signals, there are encouraging trends in the analysis of the companies that appear to support the stages of development of this emerging industry. Taking a more detailed look at the KeyStone Scores®, it is apparent that the startups and SMEs are characterized by strong differentiation of their assets (intellectual property, real assets, and management) and connectivity (supply chain knowledge and management background) in the industry. Green chemistry advancements have long been academically- and technologically- driven, rather than being incentivized by industry cost, efficiency needs, or policy responses.

Since the fossil fuel-driven development and use of raw materials in the consumer goods supply chain remains dominant, what has driven the green chemistry market?

There has been substantial activity in the development of renewable feedstocks for a wide range of chemical processes, both replacements for commonly used "merchant molecules" and new compounds with interesting and commercially valuable properties. Claimed advantages for renewable feedstocks over conventional derivations from petroleum include lower greenhouse gas emissions, reduced toxicity, and lower costs. Most renewable feedstocks are produced through biological processes – primarily fermentation of plant sugars into the desired compounds or their intermediates – or thermal and chemical processes applied to cellulosic materials such as wood, agricultural waste, or non-food plants like switchgrass. In Finland, startups have started to consider bio-based pulp waste feedstock for new raw materials.

The evolution of the green chemical market is being driven by a combination of technical, regulatory, consumer preference, and economic factors[6]. Improved chemical screening technology and advances in the science of mechanistic toxicology have improved our understanding of the effects of manmade chemicals on humans, animals, and the environment. The rapid advances in biotechnology achieved over the last several decades have created powerful, new toolkits for the manipulation of organisms (bacteria, yeasts, and algae) such that they produce industrially useful compounds with great efficiency and minimal waste.

Targeting economic development towards strength in selected sectors of emerging industries

In economic development discussions, investment strategies and vision statements tend to be very aggregate. Stimulating the Cleantech economy or the bioeconomy – for example – is a very generic strategic objective. The challenge with these high level articulations is that many economies are competing in this space, and therefore the value from a foreign direct investment (FDI) or trade perspective rapidly loses steam and meaning.

Foreign direct investments by multinational enterprises (MNEs) are one of the main drivers of globalization and of the creation of global value chains (GVCs). Both inward and outward FDI is important to many economies, and links production across countries. In Finland, many corporate enterprises are subsidiaries of, or investments from, global MNEs. Since MNEs account for a substantial part of international trade flows – both within the firm and with arms-length trading partners – a well-articulated national policy strategy is at the core of successful FDI marketing and incentivation.

In Finland, Finpro helps SMEs go international, using export credit vehicles, and by encouraging foreign direct investment in Finland with taxation and other benefits. Clear delineations of the internationalization strategy in building green economies – asking what sectors of those emerging industries does the country have strength - are necessary. They send a message of how Finland's competencies are different from those in Sweden, Germany, or the UK. Delineation of sectors of strength and innovation articulate the value of FDI in the Finnish economy to aspiring corporate and financial investors from Europe, the US and Asia.

The financial network mapping tool discussed in the previous chapter, coupled to the sourcing and assessment of companies detailed in this chapter, provides a systematic approach to understanding the strengths and weaknesses of resources in the economy. On its website, Invest in

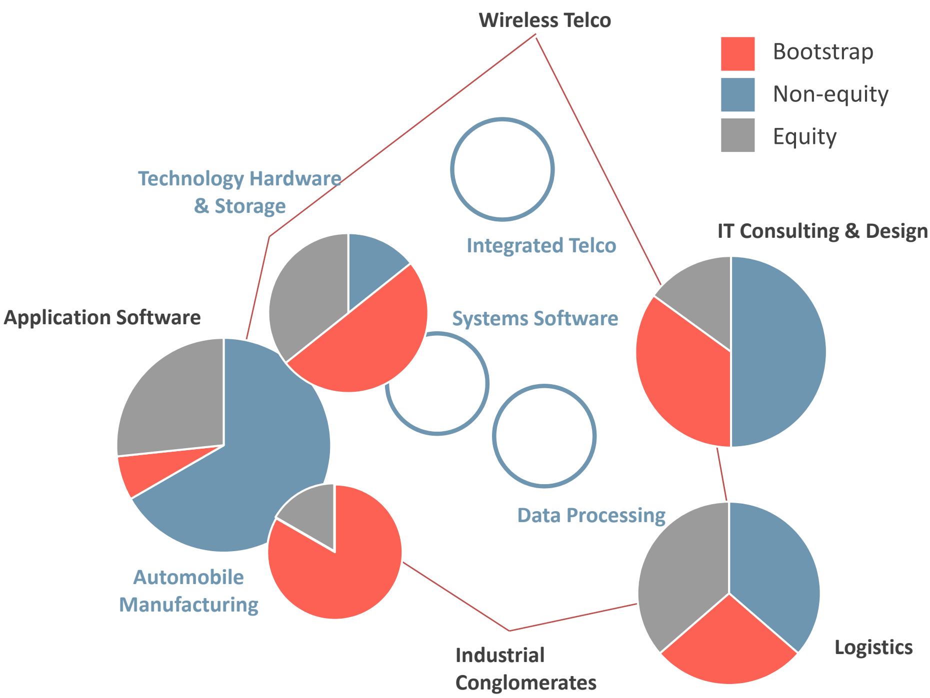
Finland indicates broad opportunities in the bioeconomy, Cleantech, healthcare and wellbeing, ICT, manufacturing, mining, and retail. As exemplified for the Smart Grid and new mobility industries – both sub-domains of Cleantech – not all industry segments that make up these industry networks are equally well represented in Finland. And not all companies in each industry segment are equally investable.

The New Mobility economy is dominated by SMEs in anchor industries

To illustrate our point, let's take a step back to the industry ecosystem of new mobility (Chapter 3). The visualization of this network is shown in Figure 4.9, and is comprised of catalyst (blue) and anchor (red) industries. We have taken all companies (69 SMEs) that were analyzed by the KeyStone Compact® process, and rated for their investment grade as an equity, non-equity, and bootstrap-grade opportunity, and mapped them in their respective industry code.

The relative size of the pie charts represents prevalence of Finnish SMEs in the new mobility industry structure. The figure shows that SMEs in the new mobility economy are represented in two catalyst industries, namely technology hardware and storage, automobile manufacturing. Strong activities are evident in multiple anchor industries,

Figure 4.9
Smart Mobility ecosystem map with overlays of SMEs and startups in anchor and catalyst industries (size of pie-chart scaled by number of companies represented)



including application software, IT consulting, and logistics. The relative dearth of companies in catalyst industries may be due to the immaturity of new mobility, and the dominance of government in public transport and mobility services.

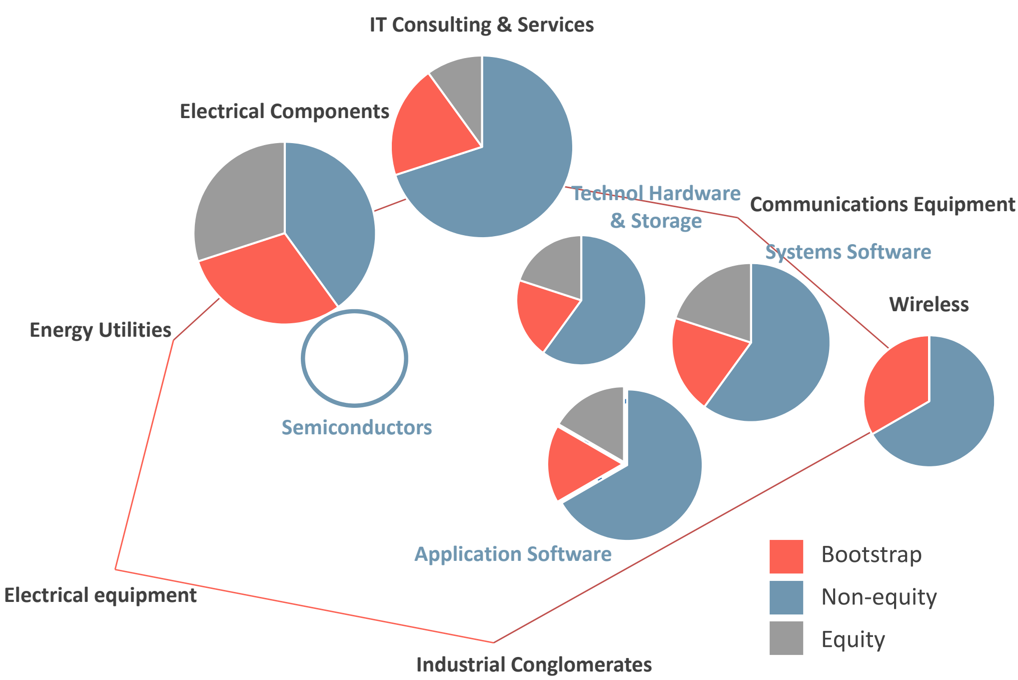
Within this classification, 25–35% of companies in logistics, application software and technology hardware exhibit characteristics of growth companies, the remainder being debt or low cost financing. Examples of high growth potential and equity investment grade companies in the Smart Mobility industry include Anadium Group Oy, ADA Drive Oy, Coreorient Oy, and Ahola Transport Oy. These companies provide information technology services, smart data interfaces for automotive services, and carpooling or logistics services. (Note: The figure reflects SME activity only. Publicly traded companies may be engaged in the other nodes of the industry system.)

The Smart Grid economy is represented by SMEs in both catalyst and anchor industries

The industry ecosystem of the Smart Grid – with the Finnish SMEs superimposed on the network map – is shown in Figure 4.10. From the distribution of companies, it is evident that SMEs with strongly leveragable assets are well-represented across the entire ecosystem. The

Figure 4.10

Smart Grid ecosystem map with overlays of SMEs and startups in anchor and catalyst industries (size of pie-chart scaled by number of companies represented)



Finnish Smart Grid ecosystem is represented in both catalyst and anchor industries. For catalyst industries in particular, technology hardware and storage, application and systems software companies are central to the ecosystem, with less than a quarter of companies being equity investment grade.

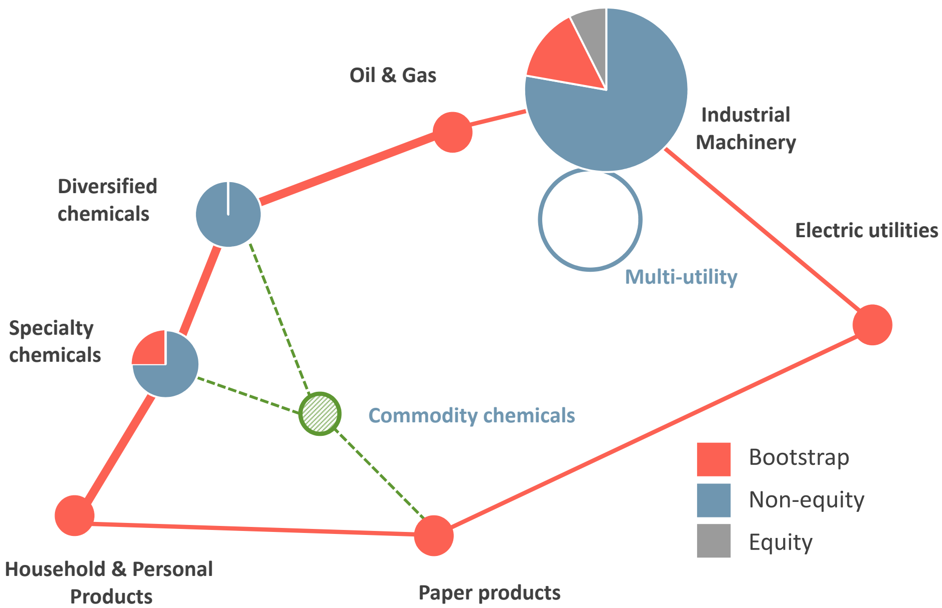
Examples of high growth potential catalyst firms include Sensire Oy, a monitoring and diagnostics company with applications in food and healthcare, that has a platform technology which can be applied in diverse markets, including energy. Nortal is a platform software solutions provider already active in the energy market, with applications such as network management, metering, and business intelligence in the fields of oil shale mining, energy production and oil production optimization. On the other hand, Elkamo Oy, is an energy storage manufacturer involved in power distribution systems.

In the anchor industries, electrical components and IT/design services are the major contributors. Nearly a quarter to one third of these companies are 'equity investable', the remainder being debt financeable or bootstrap firms. Companies such as Aidon Oy, BaseN Oy, and Enersize Oy are representatives of the high growth equity investable group. Aidon Oy is a Smart Grid and smart metering technology provider, while BaseN is an Internet of Things (IoT) operator enabled by a digitization platform. Enersize Oy is a technology company specialized in comprehensive energy saving solutions for process industry, equipment and systems

The Green Chemistry economy is overwhelmingly dominated by machining SMEs in anchor industries

The industry ecosystem that comprises Green Chemistry is dominated by anchor industries, with few financial connections mediated by catalyst industries (Figure 4.11). This is also the finding of Pike Research and Trucost research[3, 4], as indicated earlier. Our analysis of 58 companies in this industry, of which 36 are SMEs and startups, indicated that the overwhelming majority is engaged in one single anchor industry: industrial machining. With focus on the manufacturing of biofuel plants, water treatment facilities, recycling machinery, and the like, these SMEs are supportive of existing industries in the ecosystem. Of note is the large representation of water or waste-related technology providers, representative of legacy supportive industries. Industry ecosystem activities with three or more SMEs and startups are seen in the diversified- and specialty chemicals industries. Single companies show focus on the development of commodity chemicals or consumer goods derived from the paper industry, with emphasis on energy-related products.

Figure 4.11
Green Chemistry ecosystem map with overlays of SMEs and startups in anchor and catalyst industries (size of pie-chart scaled by number of companies represented)



In addition, out of 36 companies, three are venture grade, with the remainder potentially scalable to risk-debt financeable companies based on reliable offtake contracts. One notable exception as a potential catalyst company is Chempolis, a producer of patented third generation technologies for biorefining of residual biomasses: formicobio™ for the co-production of non-food cellulosic bioethanol, biochemicals and biocoal, and formicofib™ for the co-production of non-wood papermaking fibers (i.e. pulp), biochemicals and biocoal. Others active in the paper industry, such as Bioklapi, focus on the production of consumer goods such as pellets.

Summary: KeyStone Compact® analysis of industry ecosystems informs targeted economic development

The KeyStone Compact® – an algorithmic non-financial due diligence analysis of companies – shows that Finland has specific and targeted business growth opportunities in the Smart Grid, Smart Mobility, and Green Chemistry industries. It also exposes catalyst industries in which the country's SMEs are currently not active, and in which economic development strategies should be focused to drive growth of the emerging industry. Ever since Harvard economist Michael Porter introduced the concept[7], the design of industrial cluster strategies has evolved as an opportunity for systemic economic development. Not one-company-at-time, but an industry. The structure and performance of value chains that underpin industrial clusters are broadly accepted.

For example, the U.S. Economic Development Administration has embraced the analysis and design of industry clusters as important and powerful tools for policy action and economic development[8]. A key policy challenge – also pointed out by the Brookings Institution (a Washington, DC based think tank) – in the execution of green cluster designs is figuring out how regional economic strengths and leveragable assets can be translated into (export) growth markets[9].

The Multi-Asset Renewal Fund (MARF) is built on the industry cluster concept, and identifies the industry codes and companies that would be plausible candidates for investment. Even if non-financial metrics disclose valuable information on the risk profiles of companies, they need to be supplemented with rigorous financial analysis. The MARF allocation strategy for SMEs considers two asset classes: equity investment or uncollateralized risk debt. The metrics that are typically used to assess credit worthiness and valuation of companies in these asset classes differ substantially.

The next chapter provides an overview of the asset allocation strategy in each asset class.

References

1 Moore, G. A. (1991). Crossing the Chasm: Marketing and Selling High-Tech Products to Mainstream Customers. Harper Business Essentials, New York.

2 Kotiranta, A., Tahvanainen, A., Ritola, M. & Adriaens, P. (2015). Leveraging Physical Assets for Value Creation Through Cleanweb Firms: The Finnish Cleantech Space in Transition. Ross School of Business Paper No. 1279. Available at SSRN: http://ssrn.com/abstract=2611231.

3 Pike Research (2011). Green Chemistry Bio-based Chemicals, Renewable Feedstocks, Green Polymers, Less-toxic Alternative Chemical Formulations, and the Foundations of a Sustainable Chemical Industry. Market Report, Boulder, CO, US, Accessed 05042016.

4 TruCost (2015). Making the Business & Economic Case for Safer Chemistry: Report for the American Sustainable Business Council and Green Chemistry & Commerce Council. Available at http://asbcouncil.org/sites/default/files/asbcsaferchemicalsreportpresred.pdf, Accessed 05042016.

5 European Commission (2007). Available at http://ec.europa.eu/environment/chemicals/reach/reach_en.htm, Accessed 022616.

6 Anastas, P. T. & Warner, J. C. (1998). Green Chemistry: Theory and Practice, Oxford University Press, New York

7 Porter, M.E. (1998). Cluster and the new economics of competition. Harvard Business Review, pp. 77–90.

8 United States Economic Development Administration. Cluster Mapping. Available at http://www.clustermapping.us/, Accessed 081515.

9 Katz, B. & Muro, M. (2010). The New ”Cluster Moment”: How Regional Innovation Clusters Can Foster the Next Economy. Brookings Institution, Washington, DC.

5

Asset Allocation

Robustness in Combining Financial and Non-Financial Indices

Robustness in Combining Financial and Non-Financial Indices

> *However good our futures research may be, we shall never be able to escape from the ultimate dilemma that all our knowledge is about the past, and all our decisions are about the future.*
>
> – Ian Wilson, Scenario planning expert

Portfolio Investment Objectives

Managing a multi-asset strategy portfolio based on a thematic financial network map of companies is much more complicated than putting together a puzzle. There are three important stages in the process: (1) asset allocation strategy, (2) portfolio construction, and (3) performance evaluation. The asset allocation strategy will be discussed in this chapter, and describes how the decisions were made to include and exclude companies from the fund structure based on financial and non-financial risk metrics. Chapter 6 will focus on the portfolio construction of the Multi-Asset Renewal Fund – the ultimate goal of the work presented in this book. Chapter 7 emphasizes the performance evaluation of a specific portfolio using commonly accepted risk-return analytics tools in the industry.

The asset allocation strategy seeks to understand which companies should be included in the MARF

The asset allocation strategy essentially seeks to understand which companies should be included in the proposed Multi-Asset Renewal Fund (MARF), and what asset classes best fit their risk-return and growth trajectories. The financial technology approach to find efficiencies in the deal sourcing and allocation process is multi-faceted. A financial network mapping IT solution finds the original pool of companies to be triaged using the KeyStone Compact®, an algorithmic risk typology for startups, mature SMEs and corporate enterprises based on their value capture and investment grade characteristics.

In this chapter, we build on this outcome, and expand the allocation process to integrate also purely financial performance indicators in the asset class allocation strategy. The solutions approach leverages statistical models that uncover risk profiles and insights from the KeyStone Scores®, and integrates these in a workflow process with financial indicators to arrive at the most viable assignment of risk and return. Since the fund structure encompasses private debt, equity and stock investments, each of which have different liquidity and performance expectations, the triaging of companies needs to be performed at multiple levels.

> *Non-financial risk-performance profile*. Non-financial performance indicators are used to assess the activities that an organization sees as important to achieve its strategic objectives. Typical indicators relate to customer relationships, operations, market channels and the organization's supply chain or its pipeline. Non-financial measures are indicators for the firm's long-term performance.

> *Financial risk-performance profile*. Financial performance indicators are generally based on income statement or balance sheet components, and may also report changes in sales growth – by product families, channel, customer segments – or in expense categories. Accounting-based performance is contemporary and short-term, and tends to measure recent history of the firm.

The KeyStone Compact® suite of risk assessments are focused on quantifying non-financial risks, which are often viewed to represent over 70% of the investment risk or performance of companies. Indeed, a recent Ernst & Young survey on risk management by major financial institutions emphasized how banks are increasingly focusing on non-financial risk metrics[1]. Since each ecosystem is comprised of companies with a wide variety of business models and associated risks, these potential underlying assets for the fund need to be carefully analyzed based on both financial and non-financial metrics. When applied to the three industry ecosystems, metrics such as positioning for value capture, upside potential, and time to scale for enterprises as they partake in – or are entering – new industries and leverage their assets, are highly varied and informative for investment risk.

According to a November 2003 Harvard Business Review article[2], most companies rarely identify areas of non-financial performance that might advance their chosen growth strategy. Nor do they demonstrate a cause-and-effect link between improvements in those non-financial areas and in cash flow, profit, or stock price[3]. The objective is to provide an overview of how the non-financial company KeyStone Scores® were used in conjunction with accounting-based metrics to aid in risk profiling, and in allocation of companies to the MARF's unsecured private debt, equity investment, and exchange traded fund (ETF) asset classes.

Interpreting company non-financial risk factors using statistical means

As detailed in Chapter 4, risk profiling of companies using the KeyStone Compact® tool results in a quantitative score based on a set of eight categories. The categories and granularity of analysis is informed by tacit knowledge of entrepreneurs, investors, and product development managers.

Following analysis of hundreds of companies, a wide range of KeyStone Scores® was obtained, a sampling of which from the Green Chemistry industry is shown in Figure 5.1. From this figure it is apparent that the numbers range from 0–100% on some metrics, with a tighter distribution in others. For our systematic analysis of risk and of forward-looking performance expectations, but also for matching the companies with the right asset class in the MARF, we needed to design a process that utilizes these metrics and helps to answer the following questions:

- How can similarities among companies be understood and quantified?
- How can companies with similar risk profiles be clustered?
- What is the relationship between non-financial and financial risk metrics?

To answer these questions and mine the data, we employed a set of statistical analytical tools familiar to those versed in the academic and practitioner fields of econometrics and micro-econometrics: Principal Components Analysis (PCA), Hierarchical Cluster Analysis, and Regression Analysis. **Econometrics** uses economic theory, mathematics, and statistical inference to quantify economic phenomena for economic policymaking. Since we are concerned with individual firms, we focus on **micro-econometrics**, the analysis of data on the economic behavior of firms as a predictive tool for asset allocation.

This treatise is not intended to provide a technical background on each of these tools, but serves to help explain the objectives and interpretation of the analyses.

Figure 5.1
Diversity of KeyStone Scores® across ten companies

Dependency	Leverageability	Replicability	Connectivity	Diversification	Profitability	Scalability	Capital Efficiency
35.7 %	15.0 %	13.3 %	37.5 %	18.2 %	56.3 %	57.1 %	70.0 %
21.4 %	20.0 %	40.0 %	12.5 %	81.8 %	37.5 %	50.0 %	60.0 %
14.3 %	25.0 %	46.7 %	37.5 %	81.8 %	56.3 %	57.1 %	100.0 %
35.7 %	30.0 %	53.3 %	62.5 %	63.6 %	50.0 %	50.0 %	100.0 %
0.0 %	35.0 %	66.7 %	62.5 %	72.7 %	62.5 %	71.4 %	100.0 %
7.1 %	45.0 %	60.0 %	62.5 %	45.5 %	18.8 %	14.3 %	30.0 %
14.3 %	45.0 %	73.3 %	50.0 %	81.8 %	37.5 %	42.9 %	100.0 %
0.0 %	50.0 %	73.3 %	37.5 %	63.6 %	62.5 %	28.6 %	50.0 %
0.0 %	40.0 %	60.0 %	50.0 %	54.5 %	50.0 %	57.1 %	70.0 %
14.3 %	30.0 %	33.3 %	25.0 %	36.4 %	31.3 %	50.0 %	40.0 %

Principal Components Analysis helps to uncover trends in the KeyStone Compact® datasets

Principal component analysis (PCA) is a technique used to identify co-variation and uncover strong patterns in a dataset. The methodology is commonly used in the social sciences, market research, and other industries that use large data sets. The rationale for using the tool is to condense any number of variables from a large set of data into a much smaller number of uncorrelated variables, called ***principal components***. The PCA is therefore also known as a data reduction tool (Figure 5.2). The goal of the PCA is to explain the maximum amount of variance with the fewest number of principal components.

Figure 5.2
Reduction of a large number of variables (n) in a dataset to a smaller subset of uncorrelated variables (k) for easier interpretation

$$A = \begin{bmatrix} A_{11} & \cdots & A_{1n} \\ \vdots & \ddots & \vdots \\ A_{m1} & \cdots & A_{mn} \end{bmatrix} \xrightarrow{k<n} A = \begin{bmatrix} A_{11} & \cdots & A_{1k} \\ \vdots & \ddots & \vdots \\ A_{m1} & \cdots & A_{mk} \end{bmatrix}$$

Let us use the KeyStone Scores® as an example. Based on figure 5.1, each company is characterized by a set of eight scores, grouped in two sets: value capture scores and investment grade scores. The matrix of scores for one hundred companies is thus 100 x 8, or 800 combinations of scores and companies. The PCA analysis can then be applied to reduce this set of eight scores into a smaller number of 'principal components'.

Each of the principal components – in layman's terms – combines a number of the original eight scores based on their mutual correlation – referred to as ***loadings***. Those scores that exhibit either strong positive or negative correlation among themselves are grouped in a single principal component. Depending on the detailed methodology used, any single variable is significantly loaded with any of the other variables in the data in only one of the obtained principal components. Therefore, the number of principal components obtained is usually smaller than the number of original variables. In our case the PCA reduces the original space of eight variables to only three principal components with significant explanatory power.

Since the original eight KeyStone Scores® describe different dimensions of non-financial risk for a company, a combination of these dimensions basically creates risk profiles that are an expression of each of the components. In other words, instead of using dependency, leveragability, connectivity, replicability, diversification, profitability, scalability and capital efficiency as risk descriptors, the dataset is reduced to three principal components that profile the original scores into *management*, *market* and *industry risk* categories. Thus, the original matrix of 100 x 8 KeyStone Scores® transforms into a reduced matrix of 100 x 3 principal components describing three different profiles of risk (Figure 5.2).

Let us describe the three risk profiles that the respective principal components represent:

- **Management risk.** This category relates to the experience, skill sets, and connectivity of the management team and advisory board in the industry where the company seeks to grow. This risk may include product management risk, involving strategy, market trends and feature definition of a product or product line.

- **Industry risk.** This category generally describes how well the company is positioned in the industry value chain, how well it can leverage its assets, and how dependent it is on partnerships, regulatory requirements, and supply chain pressures.

- **Market risk.** This category focuses on revenue and cost structures to get the product or service to market, the sales cycles and scalability of the opportunity, adoption rates and how they are influenced by channels and regulations.

You might want to know how many principal components are sufficient for analysis and interpretation. This depends on the type of dataset and the objective of the study. Each component explains a certain amount of the total variation in the data set. The threshold for the total amount explained really depends on the setting. In this analysis, the objective is to explain underlying trends in the datasets, and find combinations of KeyStone Score® variables that can be grouped to understand types of risk embedded in the business model. Hence, as a sufficient threshold, principal components are required to explain at least 70% of the variation among the companies.

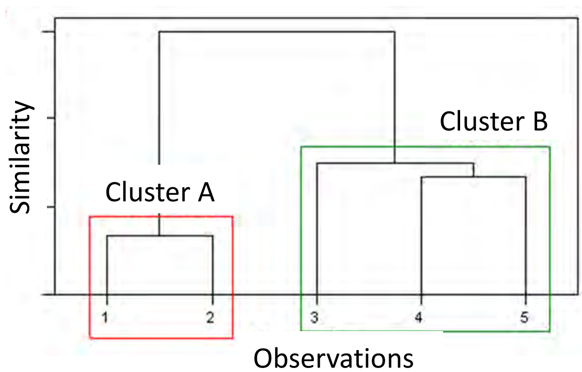
Hierarchical cluster analysis allows for grouping companies with similar non-financial risk profiles

In data mining and statistics, hierarchical clustering – also called hierarchical cluster analysis or HCA – is a method of cluster analysis which seeks to build a hierarchy of related clusters. The tool is commonly used in many areas of inquiry to organize observed data into meaningful structures or develop taxonomies of similarity. In other words, cluster analysis is an exploratory data analysis tool which aims at sorting different objects into groups in a way that the degree of association between two objects is maximal if they belong to the same group and minimal otherwise.

The hierarchical feature of cluster analysis then uses algorithms to make decisions on relatedness between the groups. The degree of association between two objects – companies, in our case – can be visualized in many simple and evocative ways. One approach for graphical representation of a matrix of distances, which is perhaps the easiest to understand, is a *dendrogram*, or tree (Figure 5.3). The companies are thus joined together in a hierarchical fashion from the closest related (the most similar), to the furthest apart (the most different).

Given this information, cluster analysis can be used to discover structures in data without providing an interpretation. In the current study, cluster analysis was used to discover similarities between companies with regard to their risk profiles, as established in the principal components analysis of the KeyStone Scores®.

Figure 5.3
Graphical representation of a dendrogram, indicating how observations are clustered based on similarity



Let us briefly demonstrate how. Assume that the PCA analysis is able to reduce the eight KeyStone Score® variables to the three aforementioned principal components: management risk, market risk, and industry risk. Each company can now be assigned what statistical analysts call a factor score for each of the three components. A factor score is a numerical metric that tells how well any given component is indicative of the companies' features and profile it is assigned to. If a company has a high factor score for a given principal component, it means that particular component represents the company well. In our example, a company that receives a high factor score for the market risk component, for instance, is more exposed to market risk than those that have a low score.

The companies receive a factor score for all three principal components separately. Therefore, each company is characterized by an individual combination of these components. Each company is exposed to some management, some industry and some market risk, according to their individual profiles. What hierarchical cluster analysis allows is a grouping of the companies by similarities in their profiles.

Regression analysis informs whether non-financial risk metrics are predictive value drivers for the firm

Regression analysis is a statistical process for estimating the relationships among variables. It includes many techniques for modeling and analyzing several variables, when the focus is on the relationship between a *dependent variable* and one or more *independent variables* – or predictors that are assumed to explain the variation of the dependent variable.

In the project described here, we have not conducted explicit regressions in the conventional understanding, but rather probed the relationship between non-financial risk metrics and accounting metrics. The rationale for conducting this type of analysis is that non-financial performance measures are sometimes considered to be leading indicators of future financial performance, while current financial performance measures – such as earnings or return on assets – are commonly considered to be trailing measures of performance. In the design of a long-term investment instrument, it is important to uncover forward-looking measures that are predictive of future performance.

The PCA analysis, and cluster analysis reveal structure in the non-financial company data. The regression analysis is intended to demonstrate the value relevance of financial and non-financial information and their usefulness in the prediction of return on assets and liquidity performance metrics. Allocation decisions will be made following aggregate analysis of the three key categories of firm value drivers: human capital, accounting information, and firm market/industry characteristics.

Case 1. Strength of SMEs in the Smart Grid industry is predominantly impacted by market growth factors

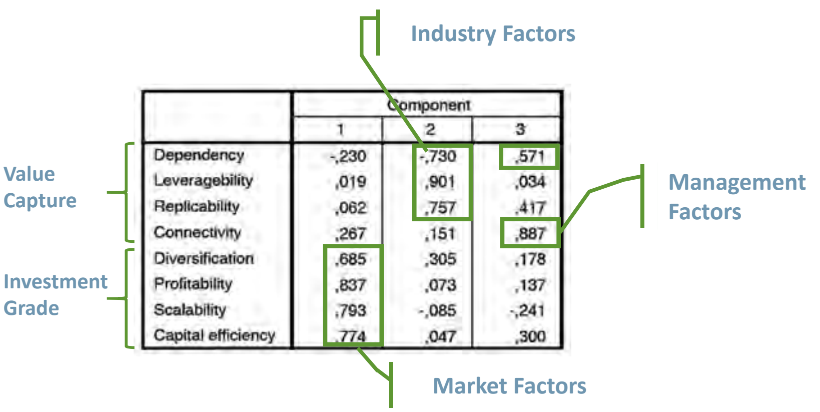
The PCA analysis of over 40 companies that passed the KeyStone Compact® assessment indicate that the three obtained components can describe 75% of the variation between the companies (Figure 5.4). The Figure shows how the eight KeyStone Score® variables are related to the three principal components, whereby the numbers represent the significance of the relationship. Interpretation of the principal components is based on finding which variables are most strongly correlated with each component, i.e., which of these numbers are large in magnitude, the farthest from zero in either positive or negative direction. Which numbers need to be considered as large or small is determined by a number of factors such as the ratio between the number of observations – companies, in our case – and the amount

Market growth opportunities are driven by diversification, profitability, scalability and capital efficiency of variables in the analysis. Given the large number of variables (8) relative to the number of companies (40+), a loading above 0.5 is deemed important.

Principal component 1 – Market growth opportunity. This component explains 31% of the variation in the factor scores, and is strongly correlated with four of the original variables. It increases with Market Diversification, Profitability, Scalability, and Capital Efficiency scores. This suggests that these four risk indicators vary together. If one increases, then the remaining three also increase, since all factors are positive. Given the variables involved, this component can be viewed as a measure of **market growth opportunity**. Furthermore, we see that the first principal component correlates most strongly with Profitability. In fact, we could state that based on the correlation of 0.837 that this principal component is primarily a measure of future Profitability, with Scalability a close second. Recall that Profitability is strongly influenced by the competitive structure of the targeted markets, their respective growth rates, the degree of commoditization of the companies' offering, expected margins typical for the targeted industry, the degree of separation from the end customer, the degree of recurrence in the revenue model and, finally, the degree of control over the sales channels. Companies that are score high on product differentiation, with high adoption rates and low sales cycles will have significant Profitability (and Scalability) opportunities.

Principal Component 2 – Strength of value chain position. This component explains 25% of the company variability, and increases with three of the variables. Specifically, it increases with Leveragability and Replicability, the latter being a measure for product differentiation,

Figure 5.4
Principal components analysis of SMEs and startups in the Smart Grid industry ecosystem



	Component		
	1	2	3
Dependency	-,230	-,730	,571
Leveragebility	,019	,901	,034
Replicability	,062	,757	,417
Connectivity	,267	,151	,887
Diversification	,685	,305	,178
Profitability	,837	,073	,137
Scalability	,793	-,085	-,241
Capital efficiency	,774	,047	,300

and with *decreasing* Dependency. Hence, if the two former variables increase, the latter decreases. This component can be interpreted as a measure of **strength of industry value chain position**, particularly due to its high correlation with Leveragability. Recall that this variable measures a company's ability to exploit its assets and partners to its own advantage, including core partnerships via contracts, joint ventures and other agreements but also the fierceness of the competitive environment and the degree of concentration in the industry. In other words, companies with a high degree of leverage will be able to attain a strong position in the industry value chain, and reduce their dependencies in the industry.

Principal Component 3 – Management experience. The third component explains 18% of the variation among company scores, and is related to two factors. These are Connectivity and increasing Dependency. It is suggestive that as the Connectivity of the management team in the industry in which the company seeks to innovate increases, Dependency on partners also increases. Given the strongest correlation (0.887) with industry connectivity, this component is a measure of **management experience.** This may indicate that a management team and advisory board with deep knowledge of the supply chain and relationships therein to bring products and services to market know how to seek out partners, but thereby increase industry dependencies.

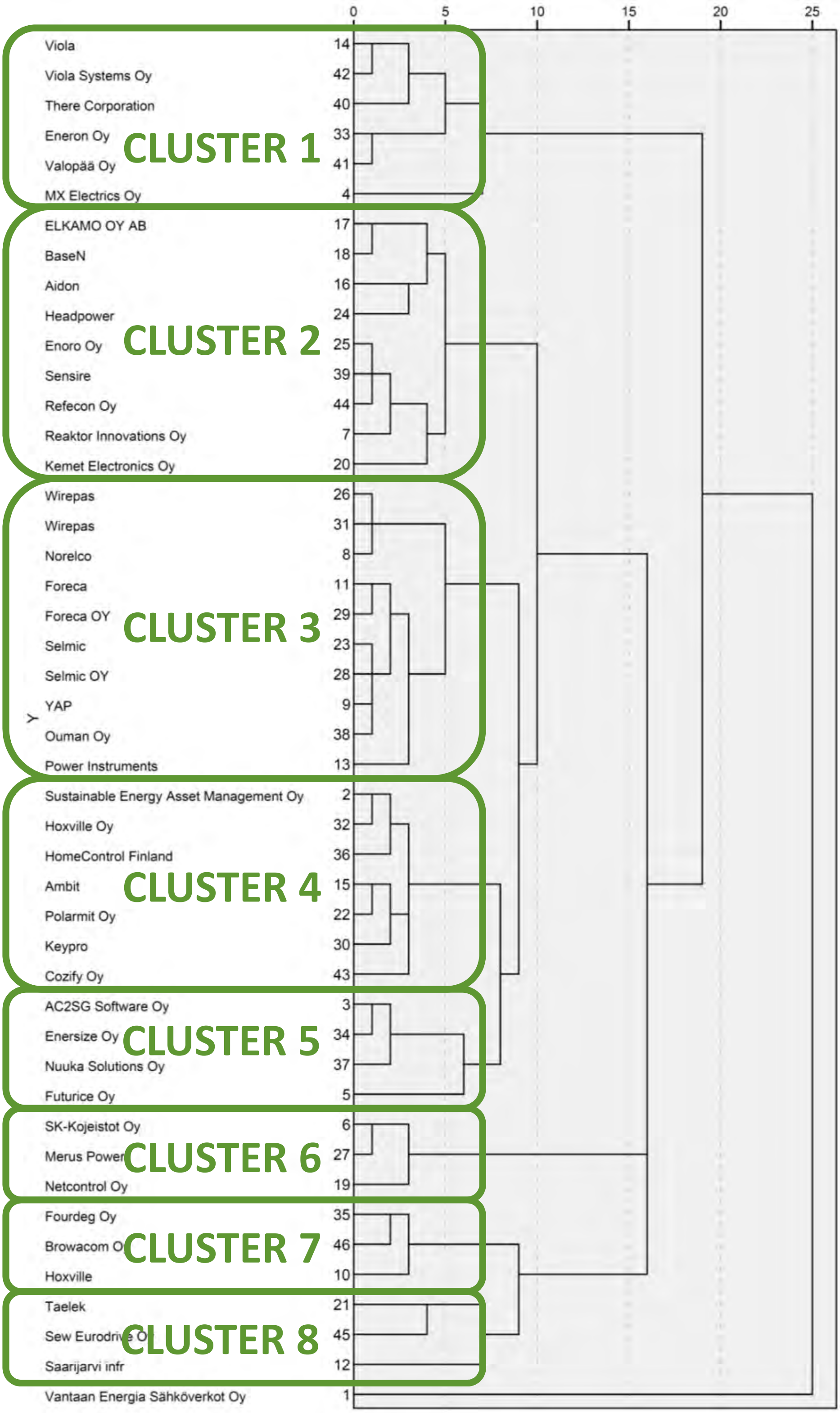
Clustering of SMEs in the emerging Smart Grid industry supports eight company profiles

Using the related factor scores for the three principal components as input, hierarchical cluster analysis of each company indicates that up to eight clusters can be identified based on the relatedness of the companies' factor score profiles (Figure 5.5). A number of replicates such as Foreca, Wirepass and Selmic were included as an internal check for consistency of the KeyStone Compact® analysis.

As a result of the cluster analysis, it can be concluded that forward-looking, non-financial performance metrics are indeed capable of differentiating between companies based on market growth factors, strength in the value chain, and management experience (Figure 5.6). Importantly, this clustering is irrespective of the industry code or the value chain segment of the Smart Grid industry the companies operate in.

> Example. Aidon and BaseN in Cluster 2 are classified under the '*Manufacture of instruments and appliances for measuring, testing and navigation*' and '*Data Processing*' industry codes, respectively. The contributions of Principal Component 1 (Market Growth) and Principal Component 2 (Industry Strength) are lower for Aidon than for BaseN, but Principal component 3 (Management Experience) is higher. The contributions are all strongly positive. When Aidon in Cluster 2 and

Figure 5.5
Hierarchical cluster analysis and dendrogram of companies in the Smart Grid industry



Eneron in Cluster 1 are compared, Eneron has negative loading factors for Market Growth and Management Experience, and lower Industry Strength. Hence, the statistical relatedness algorithm places these companies in different clusters.

Visualization tools help in drawing connections between non-financial and financial risk metrics

Before moving on in the process, let us briefly recap what has been achieved so far. The ultimate objective of the asset allocation process is to assign companies – qualified for investing by the value capture and investment grade analyses discussed in the previous chapter – to those asset classes of the MARF that are compatible with their risk profiles, on the one hand, and their financial performance, on the other. Both the principal component analysis and the subsequent clustering of companies have served the former purpose. They have helped to profile companies according to their characteristic risks and cluster them into groups of companies that share similar risk profiles. What we have achieved is to measure and utilize, for allocation purposes, key *qualitative* (non-financial) risk features of companies. So far so good.

Investors consider both qualitative and quantitative metrics

That being said, we know investors and financial markets traditionally also rely on more tangible, *quantitative financial metrics* when considering the fit of any given investment vehicle with investment targets. While the qualitative metrics we captured in the previous steps are forward-looking and gauge the risks involved going forward in time, traditional financial metrics – such as EBITDA, ROE or profit margins – measure past and current performance. To get a holistic view of the risks and the potential involved in their investments, investors consider both qualitative and quantitative dimensions. They complement each other.

Therefore, we have to consider also financial performance metrics in our allocation process. Before plunging straight into yet another battery of analyses, let us first develop an in-depth understanding – a rationale – of how the established qualitative risk profiles tie into and help inform the interpretation of the respective financial metrics. After all, they are expected to complement and support, not contradict each other. To understand the ties, we need to take a step back and take a closer look at the profiles of the individual company clusters.

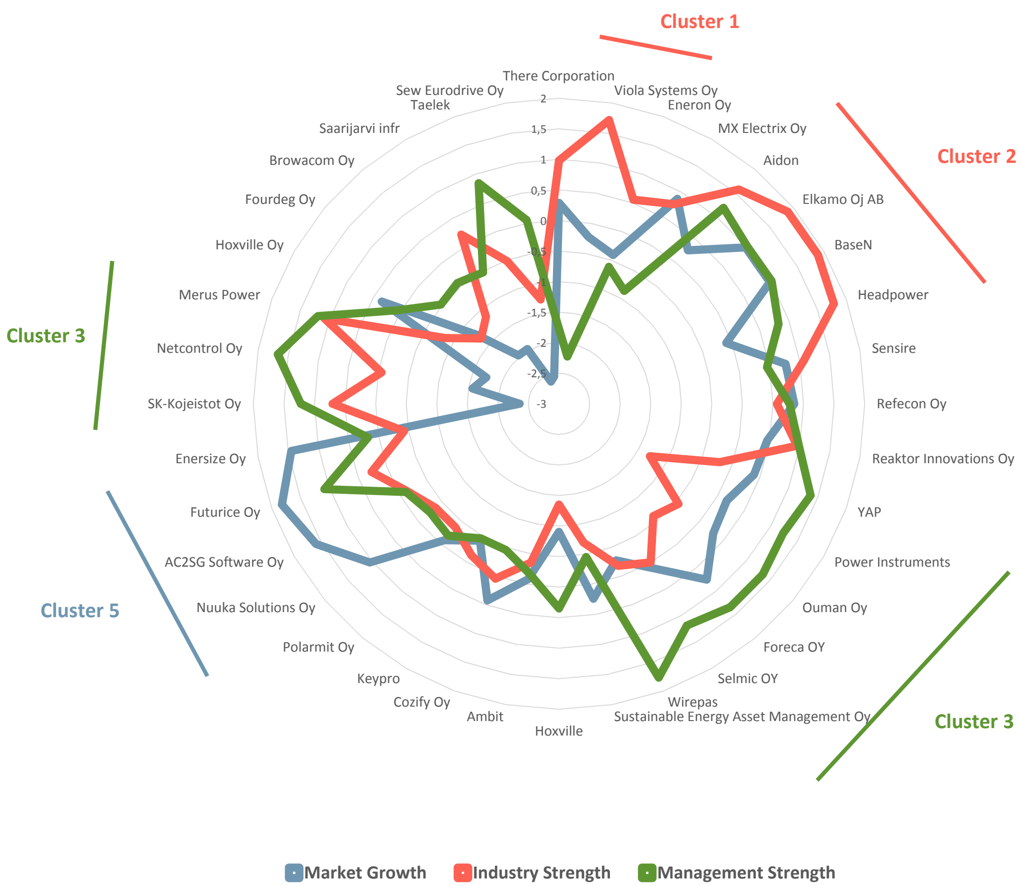
We have to relate the risk features of company clusters to the physical business environment

The interpretation of data structures behind hierarchical clustering and the loadings of principal components for each company is not a straightforward business. The challenge is that we ultimately have to relate the risk features of the individual company clusters to the physical business environment of the business. This is the environment that financial performance metrics are designed to gauge. Hence, this is also where our qualitative cluster metrics need to meet the financial ones. Our next step, therefore, is to understand the **real-world business dynamics** behind each of the company clusters.

One approach is to visualize the clusters and their underlying risk profiles in different formats, as shown in the dendrogram, and the shortly introduced radar and bubble plots.

The **radar plot** (Figure 5.6) shows how well each of the three qualitative risk profiles – market, industry, and management risk – represent individual companies in the various clusters. The radar plot allows for teasing out strengths and weaknesses among the company clusters by way of showing which of the three risk profiles dominate and are most characteristic for each company. Companies in clusters 1 and 2 appear

Figure 5.6
Radar plot of PCA factor scores for cluster companies in the Smart Grid industry



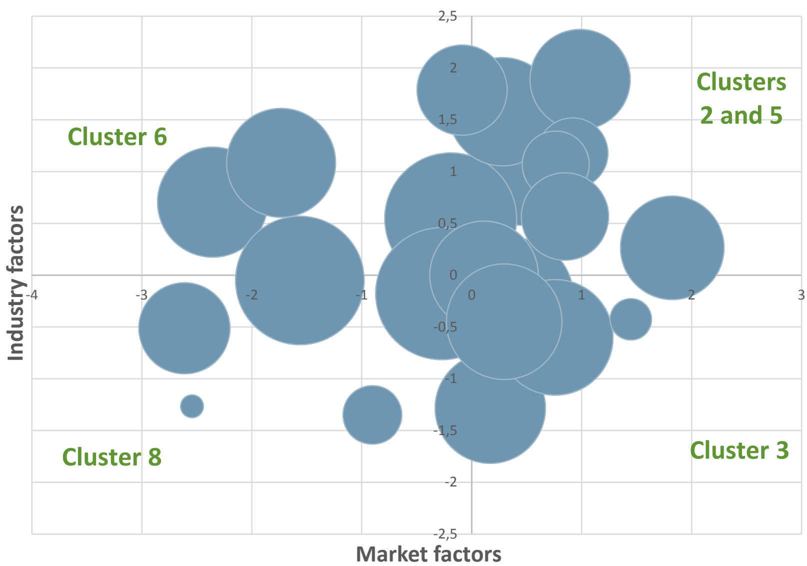
to be characterized by exposure to risks related to their position in the industry, whereas companies in cluster 3 are differentiated by their exposure to management strength issues. Cluster 5 companies are set apart by exposure to market growth factors.

To further understand the dynamics of the risk profiles identified within the company clusters, we have to shed light on their interdependencies. Here, we focus particularly on how management strength is related to industry positioning and market growth opportunity between the companies. For investors, especially those interested in funding growth companies, the assessment and viability of the management team is key. Some investors we engaged with claimed that management is the most important single asset they consider when assessing an investment candidate. An argument can be made that some companies may have deficiencies in their management strength to help position the company in its industry, and drive market growth. Understanding these relationships within the observed clusters will help us in interpreting the related financial indicators.

We use **bubble plots** to uncover the interdependencies between management and the two other risk dimensions in the clusters. The bubble plot (Figure 5.7) maps the factors scores of the first two principal components – market and industry risk – for each company along the respective axes, and represents the score for management impact by the

Figure 5.7

Bubble plots of industry, market and management profiles of the Smart Grid cluster companies. Bubble size represents the magnitude of contribution of management factors.



size of the bubble. The map shows there are four broad groupings of clusters:

1. Company clusters in which management factors are positively correlated to industry strength and market growth opportunity (clusters 2 and 5);
2. Company clusters in which management factors are positively correlated to market growth opportunity only (cluster 3);
3. Company clusters in which management factors are positively correlated to industry strength and positioning only (cluster 6); and
4. Company clusters in which management factors are negatively correlated to industry strength and market growth opportunity (cluster 8). Since only positive contributions are represented, clusters 1, 4 and 7 as well as some outliers in the featured clusters are not included.

What do these results tell us about the real-world business dynamics of the companies?

The interpretation of the positioning of clusters and cluster companies can be tied back to the original PCA results. The management's deep knowledge of supply chains, industry relationships, and ability to structure beneficial partnerships should positively correlate with strength of the company in the industry, and market access.

Clusters 2, 5, and 6 represent companies with apparent capacity to build a position of value capture. Clusters 2, 3, and 5 appear to be able to leverage this industry connectivity to access market growth opportunities. Companies in cluster 8, in spite of positive management factors, have not been able to build a position of strength or gain significant market growth. Clusters 1, 4, and 7, in which management, industry and market factors are all negatively correlated may indicate significant outside factors that influence the industry and market, unable to be overcome by the managements' connectivity in the industry. These may include issues such as: the market may not be ready, and the strength of positioning is weak because the industry is immature to begin with.

Whether the relative position of the companies is reflected in the financial metrics frequently used by investors will be explored later in this chapter.

Case 2. Strength of SMEs in the emerging Smart Mobility industry is predominantly impacted by product management factors

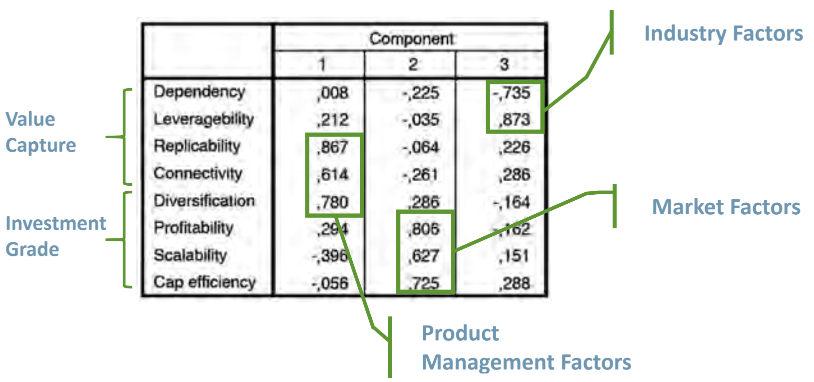
Let us have a look at a second example. The KeyStone Scores® for fifty companies in the Smart Mobility ecosystem were analyzed using PCA, resulting in four principal components explaining 79% of the variability, and three components explaining 67% of the variability (Figure 5.8). Given the large number of variables (8) relative to the number of companies (50), a correlation value above 0.5 was deemed important for further analysis. As before, the principal components end up grouping selective variables that can be interpreted as follows:

Principal component 1 – Product management strength. This component explains 25% of the variability among companies, and is strongly correlated with Replicability – i.e. the degree of differentiation of the business – Industry Connectivity, and Market Diversification. All explanatory relationships are positive, so they can all be expected to increase if one factor increases. Counter to the case of the Smart Grid industry, the Replicability variable is strongly correlated (0.876) with this principal component in the Smart Mobility industry. The second strongest is Diversification, indicating that companies in this emerging industry are set apart by highly differentiated platform offerings, and a management structure that has strength in the integration of mobility services. This component can be viewed as a measure of **product management strength**. In other words, companies with a high degree of differentiation in platform technologies will be able address diversified market opportunities.

Principal component 2 – Market growth strength. The second component is strongly correlated to Profitability, Scalability and Capital Effi-

Figure 5.8

Principal component analysis of SMEs and startups in the Finnish Smart Mobility industry



	Component		
	1	2	3
Dependency	,008	-,225	-,735
Leveragebility	,212	-,035	,873
Replicability	,867	-,064	,226
Connectivity	,614	-,261	,286
Diversification	,780	,286	-,164
Profitability	,294	,806	-,162
Scalability	-,396	,627	,151
Cap efficiency	-,056	,725	,288

ciency, and explains 22% of the KeyStone Score® variation. This is very similar to the **market growth strength** observed in the Smart Grid industry. All factors are positively correlated and, thus, likely increase together. The score for Profitability shows the strongest loading with the component, influenced by the competitive structure and growth rates of the target markets, lack of product commoditization, high expected margins for software services, direct engagement with the end-customer, recurring revenue models and high degree of control over the sales channels. The high correlation with Capital Efficiency supports the product-as-a-service (XaaS) business model in this industry.

Principal component 3 – Industry strength. This component explains 20% of the variation among companies, and is strongly loaded with two factors: increasing Leveragability and decreasing Dependency. As described previously in Chapter 4, Dependency on supply chain partners, policies and other skillsets is the other side of the coin of Leveragability. It explains why the factors are loaded in opposite directions. A company with high capability to leverage its assets will experience low dependencies on complementary capabilities in the supply chain. Conversely, a company that depends on supply chain partners that exert a lot of influence over bringing products to market will have low leverage of its assets. Hence, this component is a measure of **industry strength**.

Clustering of SMEs in the emerging Smart Mobility industry supports seven company profiles

How do the companies cluster with respect to their risk profiles? Based on relatedness of the principal component profiles of each company, up to seven clusters can be identified. To arrive at the clustering, we used the factor scores of each principal component for each company (Figure 5.9). One random replicate, Oceanvolt Oy, was included as an internal check for consistency of the KeyStone Compact® analysis.

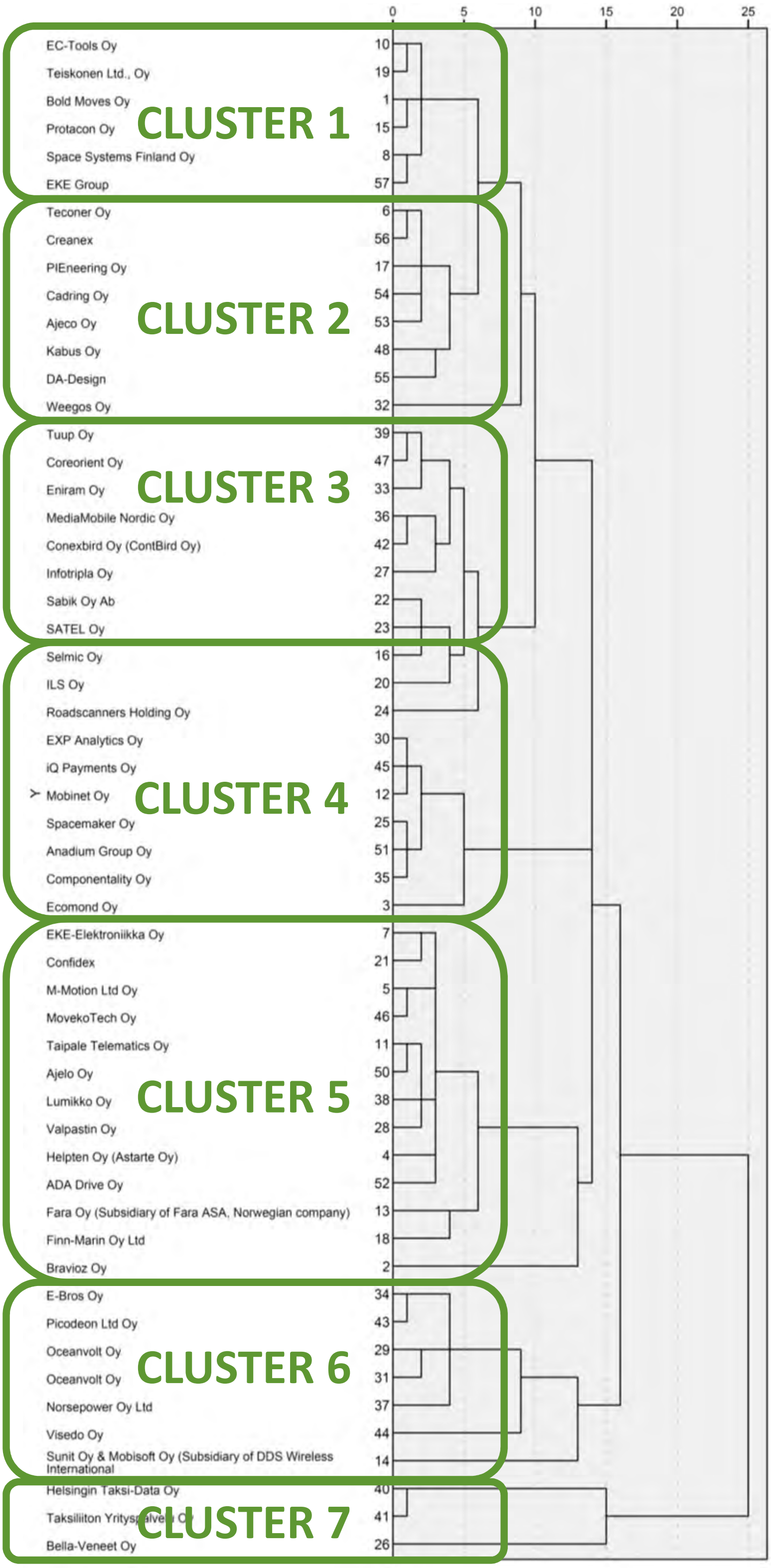
Cluster analysis corroborates the cross-industrial structure of Smart Mobility

The results show again that forward-looking non-financial performance indicators can indeed be used to profile and differentiate companies based on product management factors, market growth, and industry strength factors. Importantly, this clustering is agnostic of industry codes and value chain segments of the Smart Mobility industry the companies operate in; the cluster analysis profiles cross-sectoral companies with similar strengths and weaknesses.

Let us look at an example. Mobinet and iQPayments (cluster 4) are classified in the '*Business and Management Consultancy*' and '*Data Processing*' industry codes, respectively. The contributions of Principal Component 1 (product management) is positive for both companies and Principal Component 2 (market growth) as well as Principal Component 3 (industry strength) are negative for both. The contribu-

Figure 5.9

Hierarchical cluster analysis and dendrogram of companies in the Smart Mobility industry



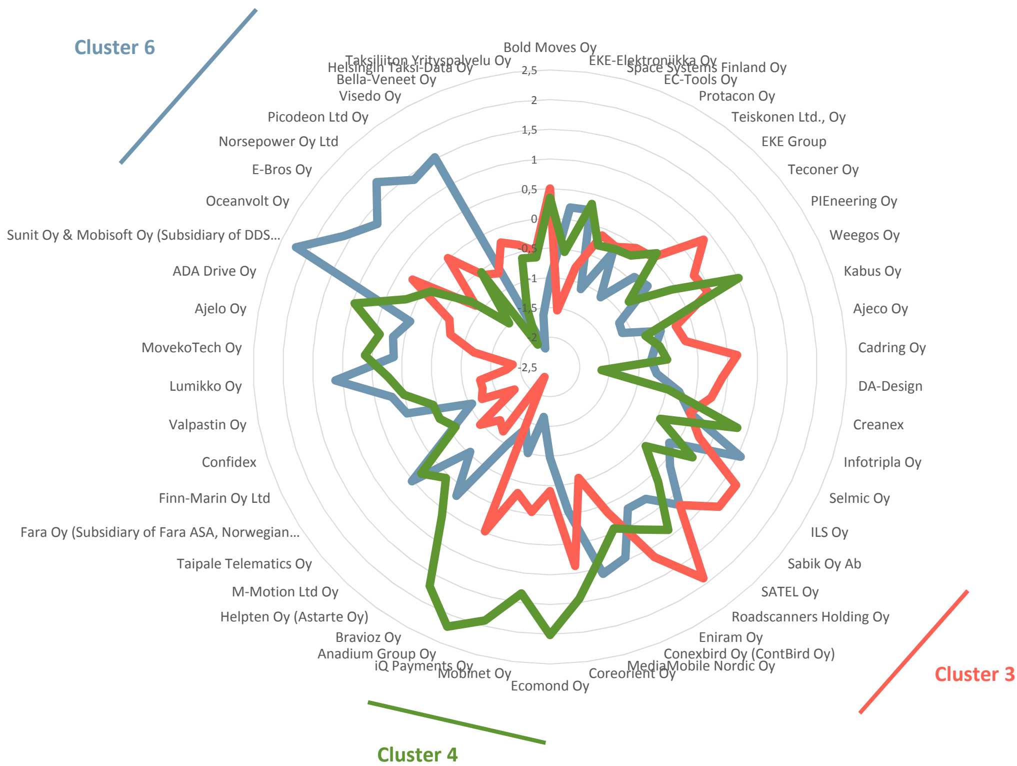
tions are similar in magnitude. On the other hand, when Mobinet (cluster 4) and Selmic (*Manufacture of Electronic Components*; cluster 3) are compared, Selmic shows negative loading factors for Product Management, while exhibiting positive contributions for Market Growth and Industry Strength. Hence, the statistical relatedness algorithm places these companies in different clusters.

Similar to the observations in the Smart Grid industry, once the company's weaknesses are identified, remedial action can be designed. Companies with negative Product Management contributions will benefit from product design and market understanding, as well as from the services of an executive search firm. Companies with negative contributions of Market Growth may require a new business model or marketing assistance, while those with negative contributions of Industry Strength may need to consider changes in partnerships or pivot in the industry value chain. A deep dive in the underlying KeyStone Compact® assessment of the company is required to pinpoint weaknesses in all the variables used for the PCA.

A more in-depth interpretation of the cluster analysis is supported by the visualization of the factor scores for each principal component and company, as plotted in the **radar chart** below (Figure 5.10). Based on this chart, it appears that companies in the various clusters exhibit vari-

Figure 5.10

Radar plot of principal component factors for all Smart Mobility SMEs



able profiles of industry strength, market growth potential and management strength. Company cluster 3 is differentiated by a strong contribution of industry strength, while cluster 4 is strongly characterized by product management factors. Market growth factors well characterize companies in cluster 6. The main difference between Smart Mobility and Smart Grid companies is that product management and industry strength are less well represented, arguably due to the more immature nature of this emerging industry. That said, the non-financial factors provide early market signals for the positioning and strength of companies in Smart Mobility.

A **bubble plot analysis** was used once more to map the relationship of product management factors to the market growth and industry strength factors. The outcome (Figure 5.11) appears to support the hypothesis in the previous chapter that both Smart Mobility companies and the ecosystem itself tend to be less mature than Smart Grids. We made two main observations:

1. There is an under-representation of Smart Mobility companies in the upper right quadrant of Figure 5.11, exhibiting positive correlations between product management, market growth opportunities and industry strength;

2. The contribution of product management factors is highly variable, indicating that these factors are still evolving in this industry.

Figure 5.11
Bubble plots of industry, market and management profiles of the cluster companies. The size of the bubble represents the magnitude of contribution of management factors.

Companies from only three out of seven clusters are represented in this plot – clusters 3, 4 and 5. They are the only ones demonstrating any meaningful product management strength. As a quick reminder, the contribution of management to a company's success is valued extremely high by investors. A company may very well be endowed with other strengths and, yet, be ignored by the investment domain if it lacks strength in management.

In contrast, cluster 3 companies indicate a positive correlation between contributions of product management on industry strength and market growth, or only on market growth. Companies representing cluster 4 tend to have a strong positive correlation between product management and industry strength. Companies from cluster 5 are mixed in with clusters 3 and 4, and have either a positive correlation with market growth, or negative correlations with both market and industry factors.

Financial metrics reveal that SMEs in the Smart Grid domain are more mature than those in the Smart Mobility industry

Now that the companies have been systematically analyzed for non-financial risk metrics, the discussion of the use of financial accounting metrics as an investor-driven and complementary step in the asset allocation process is pertinent. The objective of this section is to understand how the non-financial measures for the companies in the Smart Grid and Smart Mobility industry can be used together with accounting metrics to make decisions about asset allocation strategy. To this end, financial metrics of the company groupings – obtained from public company registries in Finland – are averaged and compared between the clusters.

As stated earlier, accounting metrics are current or short-term indicators, whereas non-financial performance indicators are often used to understand forward-looking growth opportunities. The limitations of financial metrics in assessing performance for emerging economies such as new mobility, Smart Grid and Green Chemistry generate demand for non-financial measures appropriate for evaluation of shareholder value creation[2, 4–8].

Rarely is the relationship between both systematically investigated, and when it is, the research emphasizes specific investment classes, e.g. debt default, equity valuation, or stock price trends. Let us briefly shed light on the kinds of information used in the assessment of the two illiquid investment asset classes incorporated in the MARF, equity and debt. For a detailed treatment of the four asset classes of the MARF, please see the next chapter.

Equity Investment: Equity investors use a wide range of accounting and non-accounting information and techniques relating to the specific factors concerning a particular investment. Unpublished accounting information and subjective information are important. Significant differences exist in the approaches to valuation and use of accounting information for valuation purposes between types of venture capitalists, according both to their stage of investment focus and whether they are captive or independent investors. Even though return on equity (ROE), revenue, and profit margins are important in computing valuations, it appears that gross margins and non-financial information informing future growth are incorporated frequently.

Equity investors use a wide range of accounting and non-accounting information

Debt investment: Post-2007, banks have been paying attention to how non-financial risk metrics can be predictors of default for small and medium sized enterprises (2). Liquidity, leverage and profitability measures such as current ratio, debt-to-equity ratio, debt ratio and EBITDA/total assets provide recent history information for default risk (8), and generally do not consider whether the company can bring the loan to maturity. Since the majority of the reasons SMEs fail is the lack of capitalization and long term planning, non-financial information that is forward-looking needs to be integrated in the risk assessment. Hence, increasingly, firm-level information such as age, type of business and industrial sector (e.g. industry insolvency) are used in conjunction with accounting information.

While the equity asset class in the MARF is fairly conventional, the debt asset class requires further introduction because of its particular nature. In the case of the multi-asset fund, the debt asset class focuses on **leveraged finance**. This is a type of funding for a company or business unit with more debt than would be considered normal for that company or industry. Levered finance is commonly employed to achieve a specific, often temporary, objective: to make an acquisition, to effect a buy-out, or to invest in a self-sustaining cash-generating asset. This type of finance generally includes two main products: leveraged loans and high-yield bonds. Leveraged loans, which are often

Levered finance is commonly employed to achieve a specific objective

Box 5.1
Mezzanine debt

A key instrument in leveraged finance that has long been used by mid-cap private companies in Europe and the US as a funding alternative to high-yield bonds or bank debt. The product ranks between senior bank debt and equity in a company's capital structure, and mezzanine investors take higher risks than bond buyers but are rewarded with equity-like returns averaging between 15 and 20 per cent.

defined as credits priced 125 basis points or more over the London interbank offered rate, are essentially loans with a high rate of interest because of the higher risk posed by the borrower. High-yield bonds are those that are rated below „investment grade," i.e. lower than triple-B.

When applying financial metrics on the assessment of assets, it should be stressed that, depending on the asset class, the specific metrics differ considerably. Companies that are suited for debt investments need to meet a different set of criteria than those considered for equity investments. At the risk of generalizing, let us briefly describe the space of financial metrics used by investors to assess the attractiveness of both debt and equity investment opportunities.

With regard to debt investments, financial ratios that are used as predictors for credit risk emphasize liquidity. A select subset of ratios is described in Box 5.2: debt ratio, current ratio, and debt-to-equity ratio. Generally, higher financial liquidity and lower leverage are desired for the company to service debt over the lifetime of the loan. Lower liquidity and higher leverage both increase the probability of default and, hence, increase the risk involved in the investment. As described earlier, the debt incorporated in the MARF is not working capital, but leveraged debt financing. Working capital is usually employed to increase the liquidity of companies to run their daily operations. It is used for purposes such as smoothing out cash flows in highly cyclical businesses and to finance outstanding receivables. Leveraged debt, in contrast, is riskier and used for financing ambitious growth opportunities, not for running business as usual.

Box 5.2
Liquidity and Leverage Metrics

1 Debt ratio: short + long-term liabilities over current + long-term assets
2 Current ratio (liquidity): current assets over current liabilities
3 Debt-to-equity ratio: short + long-term liabilities over shareholders' equity

Box 5.3
Profitability and Efficiency Metrics

1 Net asset turnover: A measure of operational efficiency – net sales over average total assets
2 Return on equity (ROE): Net profit generated per share
3 EBITDA: Earnings before interest, taxes, depreciation and amortization, relative to total revenue

With regard to equity investments, venture capital and other forms of risk capital investing heavily rely on non-financial measures, forward-looking business plans, strong management, and proof of traction in the market usually represented by revenue growth or gross margins. We use three financial metrics to compare company groupings between the clusters: EBITDA margin and return on equity (ROE), both as a measure of profitability, and net asset turnover, a measure of capital efficiency. As most equity investable companies are private, access to their financial data is rather difficult outside the Nordics and other countries with public access to such data. Therefore, the financial analysis of private companies will often involve using data of publicly traded comparables as proxies (see Chapter 7). However, since we do have direct access to the required data in Finland, we are able to use margin and capital efficiency analyses to gauge profitability, scalability, and capital efficiency of the companies.

The financial metrics were mapped for clusters of Smart Grid (Figure 5.12) and Smart Mobility (Figure 5.13) companies and show startling differences between these industries.

Smart Grid industry indicates favorable metrics for companies with strong management and industry strength profiles

With the caveat that the numbers are averages for company performance over the last twelve months, the financial metrics for Smart Grid companies are very stable and consistent between the clusters. Aside from return-on-equity (ROE), which indicates elevated numbers for clusters 2, 3, and 6, the radar diagram indicates that all Smart Grid clusters exhibit consistent liquidity and leverage ratios on the one hand, and profitability and efficiency ratios on the other. Operating margins (EBITDA) range from 12–25%, current ratios vary between 2 and 7, and debt ratios are generally below 1. Net asset turnover hovers around 5, and ROE ranges from negative to about 20.

Metrics for Smart Grid companies are very stable

Note that the clusters with elevated ROE were also the clusters that boasted the strongest management and industry strength profiles (Figure 5.6), and cluster 6 was characterized by a positive correlation of management factors to industry strength (Figure 5.7). Cluster 5, which exhibits a negative ROE, but otherwise similar ratios to the other clusters, was shown to have the highest market growth potential in the KeyStone Compact® analysis. In addition, this was one of two company clusters (2 and 5) with a positive correlation between management factors, industry strength and market growth. Cluster 2 boasts the highest

ROEs, hence, the difference between clusters 2 and 5 may be explained by stage and growth potential of the respective companies.

Figure 5.12
Radar diagram of financial metrics for Smart Grid SMEs

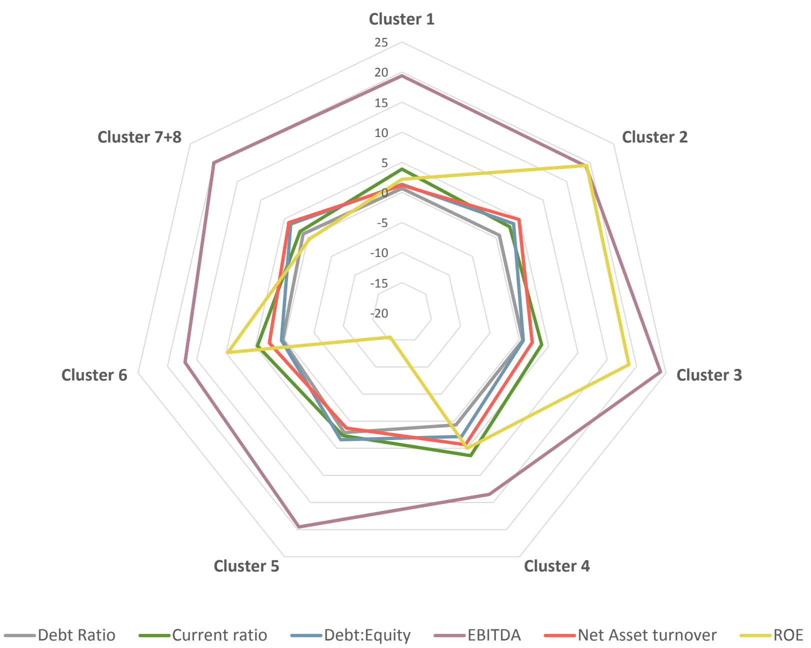
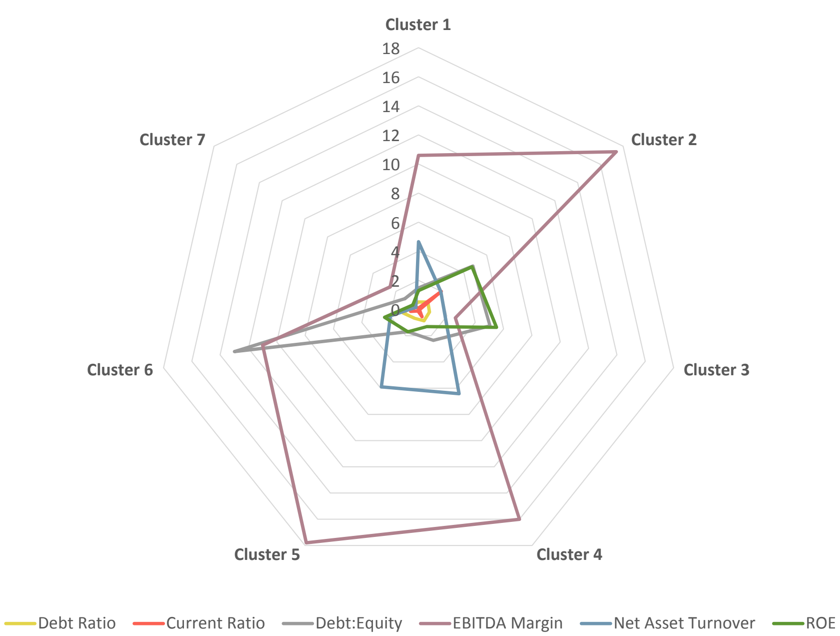


Figure 5.13
Radar diagram of financial metrics for Smart Mobility SMEs



Smart Mobility companies exhibit favorable financial metrics for clusters with strong product management profiles

The pattern is not as clear in the case of Smart Mobility companies because all metrics are highly variable. For example, EBITDA margins vary from 2-18%, and debt-to-equity (D:E) range from near zero to 12. The ROE is generally low, with only two clusters reaching similar values to those of Smart Grid companies. To call out a few highlights, two clusters (2 and 5) exhibit the highest EBITDA margins, and clusters 4 and 5 have the highest efficiency (net asset turnover) around 6.

Let us relate these observations to those from Figures 5.10 and 5.11. Cluster 3 exhibits the strongest industry strength profile, and has the highest ROE. Moreover, companies in this cluster were characterized as exhibiting a positive correlation between product management, industry strength and market growth. Product management factors were shown to be highest in cluster 4, which also showed a correlation with industry strength. These clusters have also the highest net asset turnover and reasonable EBITDA margins. Further, cluster 6 was shown in Figure 5.10 to be differentiated by strong market growth factors. In the financial analysis, this is the cluster with companies showing the highest D:E ratio, and are thus already very leveraged. Cluster 5 only appeared in the prior analysis as having companies giving weak market signals, and negative industry strength signals.

The average age of the Smart Mobility companies tends to be lower than that for the Smart Grid, and the ecosystem for private companies is very immature, compared to those in the Smart Grid ecosystem. Hence, most of these companies are likely already highly leveraged with low cost debt financing, and would not be attractive for leveraged debt financing until a later stage in their development.

Technology tools for investment analysis and asset allocation strategy

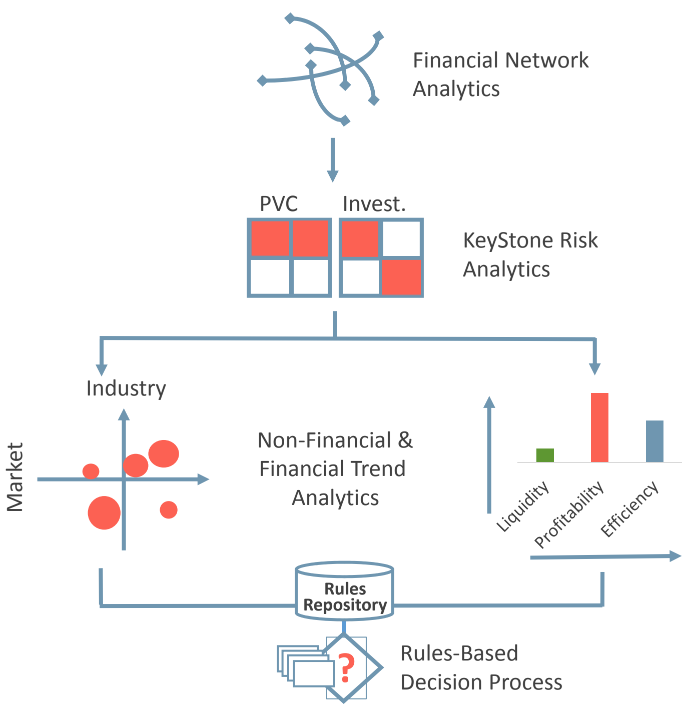
Perhaps the most evident area where financial technology ('FinTech') has impacted the world of investing is in the capabilities we now have to **analyze investments and investment strategies**. Ranging from the basics at Yahoo Finance and Google Finance to the more advanced analytical tools offered through Morningstar and Bloomberg terminals, to a host of other specialized sites for investment analysis, our capabilities for investment analysis have come a long way from where they were just a few decades ago. Data-driven tools have augmented the 'search and selection' process for stocks and portfolios but not replaced it. It is about process efficiency.

Beyond the capabilities of technology to support investment analysis, technology is also changing how **investments and investment strategies** are implemented. Online investing for the past 20 years has primarily been about picking stocks and mutual funds (and, more recently, ETFs). The latest technology evolution disrupting the world of investing is by way of so-called robo-advisors – services like Betterment and Wealthfront that construct the entire asset-allocated passive strategic (multi-asset) portfolio for the investor for a mere 0.25% of AUM or less. In addition to cost, technology offerings allow for increased levels of asset diversification with far more granularity and control.

These FinTech innovations – analytical efficiency and granularity of predictive insights – currently available in the marketplace work well for traded stocks and portfolios, but are not tailored to applications where non-financial and financial risk measures need to be integrated, such as risk management of illiquid asset allocations. This chapter aimed to expand on the asset allocation strategy in the leveraged debt and equity asset classes. Given the trends ('what') and insights ('why') of the preceding analysis, it is now possible to develop an **actionable rules-based approach** to assign companies to debt or equity investment assets.

The structure of the financial technologies underpinning the asset allocation strategy is depicted in Figure 5.14. There are four tiers in the

Figure 5.14
Rules-based asset allocation process based on non-financial and accounting metrics



process: (i) financial network analytics to gain insights on industry structure; (ii) KeyStone Compact® analytics to quantify non-financial risk drivers at a granular level; (iii) statistical analysis of non-financial and financial metrics; and (iv) a rules-based approach on how to use the insights to make decisions on asset allocation. Since all tiers have a place-based (e.g. Finland), regional (e.g. Nordic), and industry-specific (e.g. Smart Grid) character, the insights gleaned from the trends, and the rules structured based on the insights need to be adapted to the specific situation.

Finland's Smart Grid industry and market are more mature than its mobility industry and market. As a result, the KeyStone Scores® and trend analytics of companies engaged in these emerging industries vary significantly. The financial and non-financial profiles are stored separately, as inputs for the rules engine that makes the allocation decision. The rules themselves need to be manageable '*statements of actions that should be taken if certain company conditions are true*'. For example:

```
If a smart grid SME is placed in 'high_growth' PVC and
'traditional_equity' investment grade
   and a positive relation exists between management
   and both market and industry strength
   and its (efficiency metrics) ROE is greater than 10,
   and its asset turnover is between 3 and 5
      then allocate company to private equity asset class

If a smart mobility SME is placed in 'high_growth' PVC and
'traditional_equity' investment grade
   and a positive relation exists between management and
   industry strength only
   and its (efficiency metrics) ROE and net asset turnover
   are both greater than 5
      then allocate company to private equity asset class

If a smart mobility SME is placed in uncertain_value_
capture PVC and creative_capital investment grade
   and a positive relation exists between management and
   market growth only
   and its profitability and liquidity metrics meet targets
   (e.g. current ratio >5; debt ratio <5; EBITDA >15%)
      then allocate company to leveraged debt asset class
```

The target values will be different based on company, industry sector, and market maturity as well, and will evolve. In addition, based on industry practice, we have weighted the non-financial metrics higher in the decision rules than the financial (accounting) metrics. Let us use two specific examples to illustrate the rules-based allocation strategy. Aidon is a smart metering company. Its KeyStone Scores® place the company in the high growth PVC and traditional equity investment quadrants. It belongs to cluster 2, with companies that exhibit a positive relationship between management and both industry strength and market growth potential. The company shows an ROE of 5.47 and a net asset turnover of 2.54, and is thus in the 3-5 target range for its cluster and equity assets allocation. Both non-financial and financial metrics support allocated to the equity asset class. The decision will depend on shareholder preferences.

Mobinet Oy is an early stage mobility management software company. Its KeyStone Scores® placed it in the niche business PVC and non-equity investment quadrants. The company belongs to cluster 4, which is characterized by a positive relationship between (product) management and industry strength, but negative relation to market growth (in part because of the immature market). Its financial metrics indicate low liquidity, low profitability, but positive efficiency numbers, typical of a well-run early stage company, but do not meet the target values for equity investment. Given the majority weight on non-financial metrics – strong position in the industry – the company would be a candidate for equity investment.

This process was used to allocate the pool of all Smart Mobility and Smart Grid SMEs to the debt and equity asset classes for the multi-asset renewal portfolio. The list of companies considered is shown below (Figure 5.15). Note that not all companies were included in the final portfolio performance assessment.

Figure 5.15
Pool of Smart Grid and Smart Mobility SMEs allocated to debt and equity investment asset classes. Final allocation in the portfolio is further discussed in the performance assessment.

Smart Grid Industry	
Leveraged Debt	Private Equity
Sust. Energy Asset Mgmt Oy	Elkamo Oy AB
Hoxville Oy	BaseN
HomeControl Finland	Aidon
Ambit	Headpower
Polarmit Oy	Enoro Oy
Keypro	Sensire
Cozify Oy	Refecon Oy
Wirepass	Reaktor Innovations
Norelco	Kemet Electronics
Foreca Oy	AC2SG Software
Selmic Oy	Enersize Oy
Yap	Nuuka Solutions Oy
Ouman Oy	Futurice Oy
Power Instruments	

Smart Mobility Industry	
Leveraged Debt	Private Equity
Teconer Oy	Weegos
Creanex Oy	Bravioz Oy
PIEneering Oy	Coreorient Oy
Cadring Oy	EXP Analytics Oy
Ajeco Oy	iQ Payments Oy
Kabus Oy	Mobinet Oy
DA-Design	Spacemaker Oy
E-Bros Oy	Anadium Group Oy
Picodeon Ltd Oy	Componentality Oy
Oceanvolt Oy	Ecomond Oy
Norsepower Oy	
Visedo Oy	

References

1 Ernst & Young (2015). Rethinking Risk Management, EYGM Ltd, New York

2 Ittner, D. & Larcker, D. F. (2003). Coming Up Short on Nonfinancial Performance Measurement. Harvard Business Review, November 2003.

3 Chow, C.W. & Van der Stede, W. A. (2006). The Use and Usefulness of Nonfinancial Performance Measures. Management Accounting Quarterly 7(3): pp. 1–8.

4 Hussain, M., Gunasekaran, A. & Islam, M. M. (2002). Implications of non-financial performance measures in Finnish banks. Managerial Auditing Journal 17(8):452–463.

5 Hussain, M. & Gunasekaran, A. (2002). An institutional perspective of non-financial management accounting measures: a review of the financial services industry, Managerial Auditing Journal 17 (9): pp. 518–536.

6 Chenhall, R. H. & Langfield-Smith, K. (1998). The relationship between strategic priorities, management techniques and management accounting: an empirical investigation using a systems approach. Accounting, Organizations and Society 23 (3), pp. 243–264.

7 Cumby, J. & Conrod, J. (2001). Non-financial performance measures in the Canadian biotechnology industry, Journal of Intellectual Capital 2 (3): pp. 261–272.

8 Altman, E. I., Sabato, G. & Wilson, N. (2010). The value of non-financial information in small and medium-sized enterprise risk management. The Journal of Credit Risk 6 (2): pp. 95–127.

6

Multi-Asset Renewal Fund

Form Follows Strategy – The Design of a New Fund Structure

Form Follows Strategy – The Design of a New Fund Structure

> *Investing money is the process of committing resources in a strategic way to accomplish a specific objective.*
>
> – Alan Gotthardt, The Eternity Portfolio

Now that the asset allocation strategy has been described, the rationale behind the fund design and portfolio construction needs detailed consideration. Given the high degree of variability of institutional investors, the fund structure will primarily focus on yield and risk of asset classes, and combinations thereof. It is not in the scope of this book to go into detail into the fiduciary, legal and regulatory compliance requirements as required under Finnish and EU policies for occupational pension funds, given the diversity and regulatory complexities. The chapter will also not consider tax implications of regulated ('tax transfer') and non-regulated ('alternative') investment vehicles. Rather, the chapter will describe trends in capital allocation shifts and types of investments pension funds are considering in search of yield. We assume that – implicitly – these trends are in compliance with all laws and regulatory compliance matters, as required.

As an example of regulatory complexity, policies such as Directive 2003/41/EC of the Institutions for Occupational Retirement Provision, are relevant to our proposed fund structure. The Directive was designed to create an internal (EU) market for occupational retirement provision, and lays down minimum standards on funding pension schemes, the types of investments pensions may make and permits cross-border management of pension plans. Since the technical requirements under these types of directives are specific to pension funds, and do not apply to sovereign wealth funds and endowments, we leave the reader to consider other resources[1, 2]. Indeed, sovereign wealth funds are special purpose vehicles, with limited transparency take investment decisions driven by political and/or strategic objectives and considerations, or in a fashion entailing national security concerns.

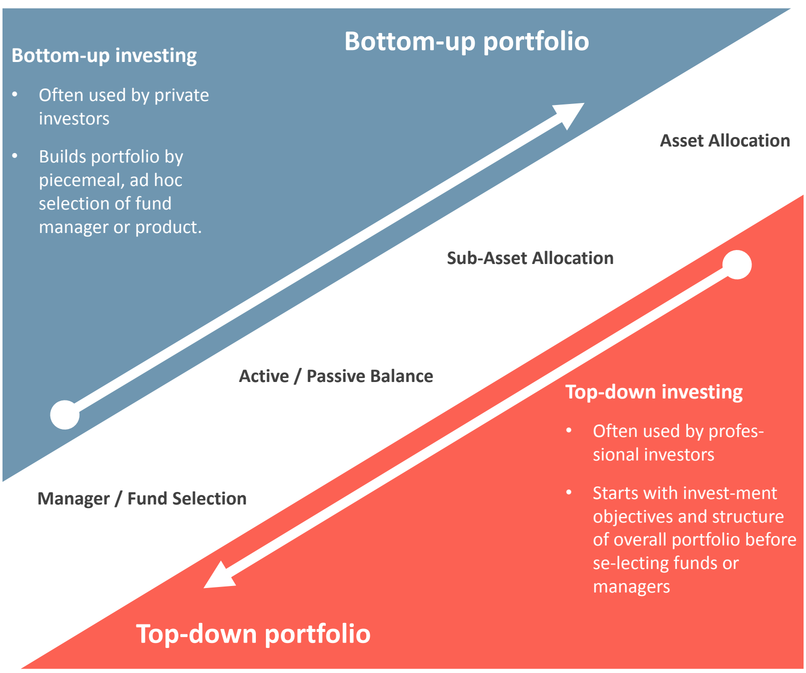
More apt to the content of this chapter, we will discuss the relevance of our new fund design in the context of the recently approved European Long-Term Investment Fund (ELTIF), which aims to combine illiquid and liquid financial assets in a single investment vehicle. ELTIFs will invest in long-term illiquid assets, such as unlisted companies, real estate and infrastructure projects. To meet its fund gathering objective, the ELTIF will be granted a European passport but will have to be managed by an authorized European Alternative Investment Fund Manager ("AIFM").

New fund structuring opportunities need to consider selection of asset classes and management models

When it comes to building a portfolio, some institutional investors focus on selecting the right fund manager or security. However, manager selection forms only a small part of the process. At a broader level, portfolio construction is a systematic process. The focus should be on structuring your portfolio such that it has the best chance of meeting your stated investment aims within your acceptable level of risk.

Professional investors begin by exploring investment risk and what they need the investment to do for them. They then work through a series of steps, creating a framework to decide which types of investments are needed. Only then do they choose individual funds or other investments. The Vanguard Group, a US investment management company with $3 trn. in assets, refers to this approach as top-down investing. This approach stands in contrast to that of private investors, who

Figure 6.1
The difference between top-down and bottom-up portfolio structuring



often start with selecting the manager or fund, rather than with the investment objective and structure.

As shown in Figure 6.1, the basic building blocks of top-down structured investments are divided into different asset classes such as equities, bonds, property and cash. These **asset classes** need to be diversified, i.e. spread across a broad mix of assets. The rationale for diversification is that investment markets move in different cycles, reflecting the underlying strength of the economy, industry trends and investor sentiment. Individual assets also move differently according to external factors, including policy changes. Portfolio diversification can help smooth out market ups and downs, such that returns from better performing assets help to offset those that aren't performing so well.

Each asset class is comprised of a broad variety of **sub-asset classes**. For example, a sub-asset class within equities might include: large companies, smaller companies, growth funds, income funds and global equities. The debt sub-asset class may be defined by early and later stage companies, as well as companies across multiple industry sectors. Just as when you combine the major asset classes, diversification is essential when choosing sub-assets. It helps to ensure that you don't take on too much risk by concentrating in a particular sub-asset class, for example holding a spread of debt at different credit risk ratings (triple-A to junk).

Actively managed funds often adopt a hands-on management style

In addition to the diversification strategy, another decision that needs to be made in portfolio structuring is on the style of the investment fund: is it the objective to **actively or passively** manage the portfolio? Is the manager to actively engage in the business of invested companies to drive the value of both the company and the respective investment, or is she not? For example, index funds simply seek to reflect the performance of the market. They work by attempting to closely track an index. The manager is not actively involved in the invested companies but only re-balances a portfolio of stocks at given intervals to follow an index of stocks that she has chosen as a benchmark. Actively managed funds, in contrast, often adopt a hands-on management style, which they hope will result in greater gains than those of an index or other benchmark, by selecting and becoming engaged with specific companies or equities. They combine research, market forecasting, and the experience and expertise of a portfolio manager or management team. Management of active or passive portfolios requires different skillsets, experience, and varies in governance costs. In recent years, actively managed funds have started to adopt financial technology innovations such as complex algorithms and 'funds in a box', an end-to-end management technology solution for hedge funds.

How do these concepts apply to the structuring of the Multi-Asset Renewal Fund?

The motivation of this project was to devise an investment strategy that would allow nations and regions to efficiently source companies and allocate investments to renew their legacy economies into green economies. In Finland, management consultants and government policy documents have defined and described various versions of Cleantech-driven economies and Bioeconomies, but they tend to gloss over investment strategies detailing how these transitions are to be executed. The strategies implicitly engage subsidies, policy-driven government investment funds, and first-loss guarantee programs (more on this later), but tend to be less specific about the engagement of market-driven investment actors.

Hence, the execution of such transitional ('renewal') investment strategies is fraught with many technical, as well as risk and return challenges, which will be discussed in this chapter. The topics include:

1. How can economic development goals and long-term institutional investor objectives be reconciled?
2. What is a green economy, and how is this tracked or assessed?
3. Does investing in green assets or markets constitute a fad, subject to policy volatility?
4. What does a diversified portfolio structure of asset classes and sub-assets look like?
5. What is the investment style and governance structure of a MARF?

The investment objective of a MARF is to drive economic development at enhanced market returns

The premise of the MARF's development work, and the need for the new investment structure is that the current financial system is broken. We claim that it is unnecessarily agnostic of potential benefits to society. With some re-plumbing of the financial system, finance could indeed be harnessed for economic development without compromising the level of returns demanded by today's professional investors. A recent paper by Luigi Zingales of the Chicago Booth School of Business argues that finance is increasingly perceived as a rent-seeking activity[3]. This means that finance is increasingly preoccupied with obtaining economic gain from others without reciprocating any benefits to society through wealth creation. A recent fascinating book, titled "*Makers and Takers: The Rise of Finance and the Fall of American Busi-*

The current financial system is broken

Box 6.1
Financialization

An increase in the size and importance of a country's financial sector relative to its overall economy. This occurs as countries shift away from industrial capitalism, thus impacting macro- and micro-economic behavior. Financialization changes the structure and operation of financial markets, and influences corporate behavior and economic policy.

Source: Investopedia.

ness (4)", further argues that in all advanced economies, most of the money in the system is used for lending against existing assets, such as housing, stocks and bonds. The unfortunate effect is a decrease in lending to small business, and increased financialization of the economy.

As a result of financialization, the pipeline from finance to economic growth has been largely shut off

Recall that the textbook definition of the financial sector is: "*The intermediation of household savings for productive investment in the business sector*." In plain words, finance was originally designed to take individual and corporate savings, and funnel them into productive enterprises, create new jobs, and drive economic growth, creating wealth along the way. As a result of financialization, the pipeline from finance to economic growth has been largely shut off. Institutional investors such as pension funds and sovereign wealth funds have been both victims and enablers of this trend, as they are looking for growth of their assets to meet their **fiduciary mandates**.

Let us explain.

Many pension funds tend to be relatively small in terms of the modern standards in the finance industry and are managed by – often part-time – lay trustees. As a result, many pension funds lack the scale and internal skills to (i) effectively and efficiently manage the increasing complexity of investment options, (ii) undertake dynamic approaches to manage the increasing volatility of financial markets, and (iii) respond to regulatory complexity. Hence, they have outsourced asset management through a combination of advisory and delegated investment services to achieve the asset owner's overall investment objectives. This is referred to as **fiduciary management**. Only asset owners that have sufficient scale – large pension funds, for instance – can organize themselves in an economically efficient and financially sustainable manner to handle this increasing complexity. The scale of the assets under management, increasing specialization as a direct result of the increasing complexity itself, and availability of increasingly powerful in-

Pension fund investing may have contributed to financialization formation technology have contributed to a further increase in the minimum size that is required to efficiently manage institutional assets.

External investment managers are generally paid based on portfolio size as well as performance based on exceeding a benchmark return and adherence to the risk parameters set by the board. Hence, pension fund investing may have contributed to financialization[e.g. 5–8].

This is where **Multi-Asset Renewal Funds (MARFs)** come in. Industrial renewal requires a cautious return to industrial capitalism, while not sacrificing the asset returns that institutional investors seek. Over the last three years, we held meetings with investment stakeholders, including asset managers, asset owners, economic developers, investment consultants, and rating agencies. Often, the structure and governance of such fund was broached in our discussions. Whereas the fund structure will be further explored later in this chapter, it is necessary to lay the groundwork for the rationale of this new investment vehicle.

1. What are the current options of asset classes included in fund structures?
2. What are the allocation strategies of institutional investors?
3. What is behind the recent trend towards multi-asset funds?
4. What is the proposed structure of Multi-Asset Renewal Funds?

When answering these questions, we will also address issues such as: "How are active and systematic risk balanced?"; "How do multi-asset funds provide diversification options?"; and "Why is this financial innovation important for the renewal of economies?".

Box 6.2
What is the financial technology innovation of the MARF?

The integration of financial network analytics and a rules-based allocation strategy of the underlying assets to allow large institutional investors and government actors to efficiently invest in and grow emerging industry ecosystems. By combining companies across the business lifecycle – from start-ups to public equities – and distributing investments over liquid and illiquid asset classes, the MARF achieves efficient blending of the real economy with the financial economy.

Going green: Multi-Asset Renewal Funds are investment vehicles for systemic economic development

An important mandate of our work is to scale investment in the greening of the Finnish economy, while creating jobs and stimulating economic growth, and generating market-driven returns for its investors. Even though we advocate a value-chain driven approach, early on it was unclear how the investment vehicle needed to be structured, what the fiduciary limitations were from an investor perspective, and how the investment mandates could result in tangible economic growth. Add to this process the aspiration to leverage existing assets and knowledge in the current economic structure such that we did not need to rebuild a green economy from scratch, and one rapidly deals with a challenge that crosses technical, financial, policy and legal dimensions.

The aspiration to transition to low carbon, 'green' economies is not new, and has been building and evolving for a long time. A key question is: What does this mean from the perspective of macro- and micro-economic investment policy? Individual companies and their supply chains do not drive an economy, the historical success of Nokia in Finland notwithstanding. Industrial renewal and transitional financing mechanisms need to take on more of a long-term macro-economic character, while stimulating the underlying assets – the microeconomics – in the country or region. To be long-lasting and perpetual, industrial renewal and the respective financing really need to be *market-driven*, they need to have economic momentum of their own. Political realities are such that subsidies will more often than not do the trick. People who defend subsidies for particular sectors often highlight the goods or services that have been produced, or the new jobs created. This may be true in the short-term; subsidies may support the development of priority projects, but they fail to build lasting growth enterprises.

To be long-lasting and perpetual, industrial renewal and the respective financing really need to be market-driven

According to the Global Subsidies Initiative of the International Institute for Sustainable Development[9], economists generally agree on two outcomes with respect to subsidies:

1. Depending on the form and conditions of the policy, subsidies have static, first-order effects, resulting in economic distortions and diverting resources from more productive to less productive uses, thus reducing economic efficiency.
2. There is a tendency over time for the benefits from subsidy programs to become capitalized into the least elastic factor of production, sometimes referred to as the "transitional gains trap", i.e. the gains are mainly accrued to those who can immediately take advantage of a new scheme.

Neither of these conditions is compatible with the fiduciary responsibilities of pension funds and other long-term investors, nor with the objective of developing green growth in industries and economies. Hence, the development of the MARF investment instrument needs to adhere to sound principles of finance as highlighted in the Green Economy Roadmap of the International Chamber of Commerce[10]. The roadmap emphasizes the essential role of business, and sets out a suite of conditions which relate to business/intra-industry and integrated policy for a transition towards a green economy. The necessary conditions for greening economies naturally include innovations in finance and investment, which are the objectives of our work here.

The MARF portfolio structure needs to reflect an industry-based green investment strategy.

Bringing together outcome-driven economic development with financial performance-driven investment and asset allocation strategies necessitates a deeper discussion on the technicalities of potential investment vehicles.

Historically, the investment in green projects – particularly sustainable energy sources and clean technology – have been relegated either to the domain of risk finance, including venture capital and private equity, or to government-subsidized investments. As technologies matured and were increasingly deployed under various environmental policies, debt finance and project finance with steady cash flows entered the financing arena. Over the last decade or so, green economic growth has been fueled by a combination of strong policy support and scalable enterprises in renewable energy generation, energy efficiency, LED (light emitting diode) lighting, and the like. More recently, public companies such as **Yieldco's** have enabled further economies of scale and competitive pricing mechanisms through business model innovations such as long-term power purchase agreements (PPAs).

Green bonds have garnered gaining interest as an asset class

Most pension funds are more interested in lower risk investments which provide a steady, inflation-adjusted income stream, including longer-term project and debt finance. Consequently, green bonds have garnered gaining interest as an asset class, particularly – though not only – with the Responsible Investment (RI) universe of institutional investors[11]. Yet, despite the interest in these instruments, pension fund asset allocation to such green investments remains low. This is partly due to a lack of environmental policy support, but other barriers to investment include **a lack of appropriate investment vehicles and market liquidity**, scale issues, regulatory disincentives and lack of knowledge, track record and expertise among pension funds about these investments and their associated risks.
To tap into this source of capital, governments have a role to play in ensuring that attractive opportunities and instruments are available to

Box 6.3
MARF Design objective

To integrate the role of governments and institutional investor needs for investment vehicles with sufficient market liquidity.

pension funds and institutional investors. This was the mission of the MARF design.

On the one hand, investments in economic development that emphasize jobs and economic growth tend to involve subsidized loans and grants for individual companies and government-financed projects, aiming **to reach policy objectives**. Sometimes, government venture capital funds or investment firms (i.e. those not required to disclose an internal rate of return – or IRR – on investment) will either co-invest or provide follow-up capital to help grow the company. In Finland, agencies and organizations such as Tekes, Finnvera, Finnish Industry Investment (Teollisuussijoitus), CleanTech Invest, and Sitra are representatives of this type of capital and investment objective. Often, these investments are driven by policy objectives, such as promoting Cleantech, the bioeconomy, healthcare, and the like. Private investment funds that make equity investments in companies often also strike a thematic, but need to demonstrate attractive IRR performance as well.

Box 6.4
Internal rate of return (IRR)

A metric used in capital budgeting measuring the profitability of potential investments. The term internal refers to the fact that its calculation does not incorporate environmental factors, e.g., the interest rate or inflation.

On the other hand, pension funds, sovereign wealth funds, and endowments **are careful to not follow a fad or policy trend**, because the longevity of these investment opportunities is not market-driven. Typically, a board of trustees sets policies for investment management and asset allocation, deciding how much of the portfolio is allocated to stocks, bonds, real estate, and other investment classes. As a result, pension funds usually don't have major allocations to direct private investment placements, but invest in funds to enable the scale afforded by pooled investments. For most public pension funds, the hiring of staff is generally governed by state and local agency regulations, while the process of soliciting and executing contracts with external professionals – including investment managers – is subject to procurement procedures and public review. Investment consultants with a deep background in finance work with staff and the board to help develop and review investment policies (Box 6.5).

Responsible investment (RI): Where pension investment strategies meet economic realities

Let's illustrate the connection between green policy objectives and institutional investment mandates using the concept of responsible investment (RI). According to the PRI (Principles for Responsible Investment), RI is "*an approach to investing that aims to incorporate environmental, social and governance (ESG) factors into investment decisions, to* *better manage risk and generate sustainable, long-term returns, and to have positive societal impact*". Some of the main drivers behind RI include the recognition in the financial community that ESG factors play a material role in determining risk and return, and the understanding that incorporating ESG factors is part of investors' fiduciary duty to their clients and beneficiaries.

Box 6.5
Bridging economic development and pension investment mandates: A portfolio model

Policy makers and economic developers seek to engage pension investors to further green policy objectives. To enable this, the investment mandate needs to shift from outcome-driven metrics to risk:return metrics, and the investment vehicle needs to be scalable; it needs to be a portfolio instead of individual companies. In a best case scenario, the investment mandate needs to be able to connect outcomes with risk:return in a meaningful manner. Thus, the MARF portfolio design and management needs to adhere to fiduciary and procurement requirements.

Hence, investment decision-making by institutional investors is starting to be impacted by ESG themes such as: clean efficient energy, environmental protection, sustainable infrastructure and development, health & well-being, and social equity. While economic developers and equity investors would tend to focus on companies and projects in these themes, ESG-driven pension funds tend to focus on the impact of environment, social and governance issues on the risk and performance of their more liquid assets.

A recent article by Bob Massie in Institutional Investor[12] – a leading investment blog – asked the question: "*As the long-anticipated flood of environmental, social and governance information has at last arrived, will data science finally allow our capital markets to grow up*?". The author aimed at addressing the need for data standardization and improvement, and the objective to link ESG metrics to financial performance. Sustainability has been moving towards the center of investment decision-making and business value creation, and has triggered an enduring debate about the relation between sustainability and financial performance valuation. Ideas have differed greatly about whether value should be understood narrowly as short- to medium-term financial benefit, or as broader societal benefit. As approaches are being explored, demand for data – and particularly standardization of data – is rising. The Sustainability Accounting Standards Board (SASB) aims to do just that, and will help pension funds, wealth funds, and endowments to com-

Box 6.6
Pension funds and ESG mandates

In a recent study, MSCI, a global index provider, distinguished three growing categories of pension fund investors: value-based, who want their portfolios to align with their principles; impact-based, who want to see measurable social returns; and long-horizon, who want to limit their exposure to systemic problems like water scarcity and carbon regulations.

bine a management point of view with leading indicators of potential financial impact.

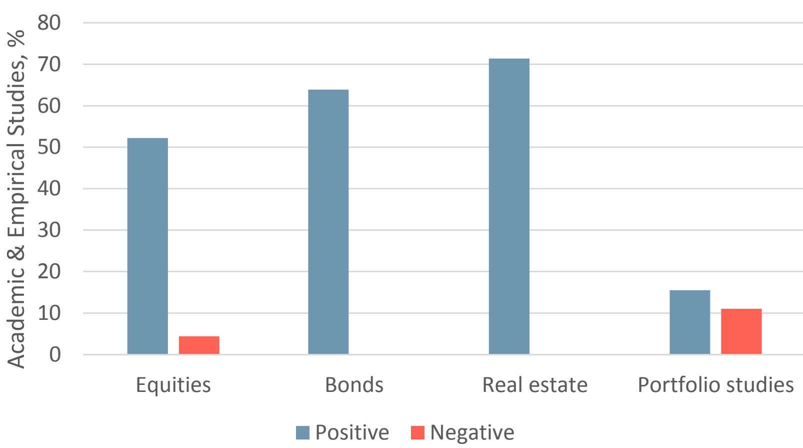
The association of global pension funds, known as the International Corporate Governance Network, has been a major driver in recognizing that capital markets do not do a good job of calculating externalities, and have otherwise started to integrate ESG in their investment decision-making (Box 6.6). These decisions have been supported by a 2015 report from Deutsche Asset and Wealth Management[13]. Covering over 2,500 academic and empirical studies, the results indicated that the relationship between ESG and corporate financial performance in key asset classes of pension funds was overwhelmingly positive (Figure 6.2). This is the type of information that pension funds and long-term investors have been seeking: the material impact of sustainability on their investment performance metrics.

The relationship between ESG and corporate financial performance in key asset classes of pension funds was overwhelmingly positive

The impact across portfolios was more tenuous, given how different screening processes are used in different asset classes. Stock performance is evaluated differently from credit risk in bonds, and real estate premiums from green buildings. This may reflect the fact that many ESG funds follow a mixture of negative and positive ESG screens, which attract a broad array of value-driven and profit seeking investors. As a result, unifying this fund group under one classification may lead to distortions and drown out various overlapping market and non-market factors.

The approaches used by investors – including pension funds – that meet investment objectives and risk profiles, include (1) benchmarking

Figure 6.2
Impact of ESG metrics on asset class and portfolio performance redrawn from 13



index funds of public companies with a minimum of revenue derived from 'green products or services', (2) project financing of green technology deployments in developing countries (so called carbon finance), and (3) structuring of new asset allocation strategies whereby the climate risk of the financial asset (company, real estate, commodity) is priced in the value of the asset.

What about the impact of ESG on alternative asset classes such as leveraged debt and private equity?

Environmental Finance, a leading online investor trade magazine, has published on the use and differences of ESG metrics between publicly traded stocks, bonds, and private equity. For example, it reports on Standard and Poor's use of ESG metrics impact on creditworthiness in oil refining and marketing, regulated utilities, and unregulated power and gas industries, where environmental regulation and weather events tend to have a more direct impact. Further, according to INSEADs Global Private Equity Initiative, private equity firms are cognizant of this trend: cost-savings potential, competitor activity and regulation all contribute to the rising awareness of ESG factors in investment committee decision-making. The focus on ESG considerations has developed alongside private credit and equity investors' growing appreciation of the impact that non-financial factors can have on value creation, long-term company performance, and the health of society at large.

Cost-savings potential, competitor activity and regulation all contribute to the rising awareness of ESG factors

In the aggregate, the design of Multi-Asset Renewal Funds with systemic economic development and financial objectives needs to be cognizant of both environmental and societal value-add and financial risk:return performance metrics to meet the trustee's mandate.

Investment momentum: Institutional investors shift towards alternative assets in search of increased returns and lower volatility

If MARFs satisfy green economic development objectives, why should economic developers, policy makers and institutional investors such as pension funds care about these new investment models? Can't they invest in currently available investment vehicles and get the same financial and green economy benefits? We argued that the right investment instruments with desired market liquidity and yield were not available (see Box 6.7).

Traditionally, institutional investors have been seen as sources of long-term capital with investment portfolios built around the three main asset classes (bonds, equities, real estate) and an investment horizon tied to the often long-term nature of their liabilities. These strategies, and the impact of financialization on the real economy, have resulted in decreased commitments to industrial investment and the real economy. In recent years – in search of yield – institutional investors have diversified their portfolios by adding allocations to alternative investments . These include private equity and credit, infrastructure debt and hedge funds, and institutional crowd investing.

Box 6.7
MARFs: A liquid alternative

Investment strategies in the financial economy and the real economy are currently separate. They engage different Limited Partners (LPs), as well as General Partners (GPs), with diverging investment committee priorities and management skillsets. MARFs combine efficient selection and allocation of diversified assets in a new alternative asset.

It is not in the purview of this book to provide an overview of all asset classes available to institutional investors. Rather, in this section, we will emphasize the challenges presented to institutional investors to find higher returns from their investments, at acceptable long-term risk. This refers to either generating **alpha**, i.e. active returns over and above an index, or **beta**, i.e. new investments that are less volatile than the market. As noted before, asset management has become increasingly complex on account of the availability of new investment vehicles, regulatory control and transparency requirements. Thus, we think it is necessary to provide the reader with an understanding of the types of asset classes that are most common to diversify risk in investment portfolios and are relevant to the fund structure proposed herein: Fixed income, Equities and Alternatives.

Fixed income is often referred to as a '**defensive asset**', while alternatives and equities are 'growth assets'. The rationale is that each of these asset classes have specific risk and return characteristics as shown in

Figure 6.3
Potential return and expected risks of defensive and growth assets

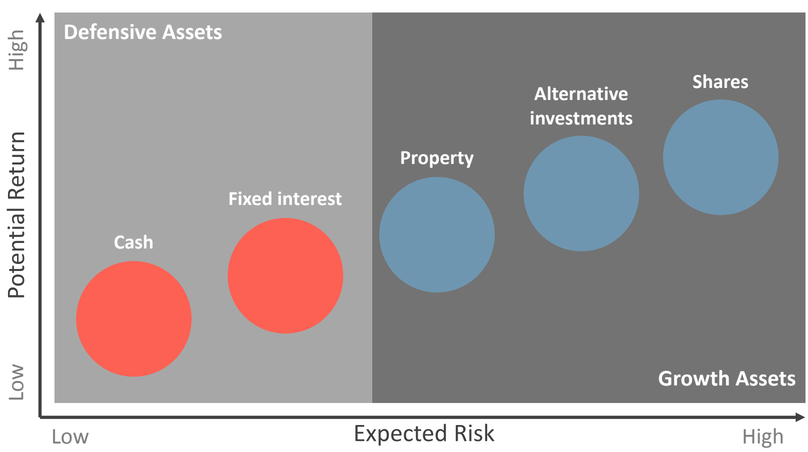


Figure 6.3. Defensive assets such as fixed interest and cash, which have for a long time been the backbone of pension investment portfolios, tend to have stable but lower returns. Alternative investments and equities, as well as listed real estate – including real estate investment trusts – tend to have higher potential returns and are considered '**growth assets**', but are significantly more volatile and subject to market uncertainties and trends.

Alternative assets represent approximately 20% of all assets under management (AUM) in North America, while lagging in Europe and Asia at about 10%

Based on an AMP Capital annual institutional investor report[14], the commitments of pension funds to alternative assets represent approximately 20% of all assets under management (AUM) in North America, while lagging in Europe and Asia at about 10%. Hence there is room to grow. EU and Asian funds are still largely dominated by bonds, but – given the low returns – are seeking to shift investments into other asset classes. For example, the pension fund of Japan and Chinese pension funds are looking at investing trillions in domestic and global equities.

Fixed income investments are the backbone of long-term investment strategies

Fixed income investments have long provided stable returns on a fixed schedule for most pension funds. Some of the most popular types of fixed income products are **bonds** issued by government, municipality, corporation, federal agency or other entity. The issuer pays a specified rate of interest during the life of the bond and repays the face value of the bond – the principal – when it matures. Many of these investments can offer tax-free returns on the municipal, state and federal levels. Individual bonds can be useful in a strategy that seeks to preserve capital and generate a predictable return when they are held to maturity, subject to issuer credit risk. Quantitative easing in the United States, high fiscal debts in Europe and Japan, and shifting economic signals in emerging markets, make it increasingly challenging for institutional investors to design policy allocations using traditional methods. Indeed, in the current market environment, bond yields are very low (from <1% to negative in the EU), and the corporate bond spread – the bonds yield relative to the yield of government bonds – is less than 100 base points (bps). This spread, i.e. the reward, is too low to take risks on some corporate bonds.

In the current market environment, bond yields are very low

Corporate bonds offer a higher yield compared to some other investments, because they are not secured by collateral. Investors of such bonds must assume not only interest rate risk but also credit risk, the chance that the corporate issuer will default on its debt obligations. Hence, institutional investors expect that if they take on this additional risk over government bonds, they will be rewarded with higher interest payments. The interest difference between the government bond and corporate bonds is called the **yield spread** or credit spread. In terms of business cycles, a slowing economy tends to widen credit spreads as companies are more likely to default, and an economy emerging from a recession tends to narrow the spread, as companies are theoretically less likely to default in a growing economy. In the current environment, the reward for extra risk is very low, hence, the corporate bond environment is viewed as being very conservative and thus not attractive to investors.

In the current environment, the reward for extra risk is very low

In recent years, some fixed income funds have been diverted to **climate bonds** issued by governments, multi-national banks or corporations. Key issues in the green bond market right now are that they have low yields and are becoming unattractive. The reason is that over 45% of all climate bonds are AAA rated, and thus are very conservative, resulting in average yields between 2 and 7% (corporate issues), with an average duration of five years. While they do not pay a premium over regular bonds, they have become attractive financial investments for long-term investors, in part because climate bonds help to diversify the funds' ESG rating.

Another shift is the emergence of ***infrastructure bonds*** as a complement or substitute for fixed income allocations (see also alternative investments). The surge in public debt since 2008 impedes government efforts to finance infrastructure. Banks, which also used to fund much of it, are increasingly loath to do so as they decrease loan books in response to tougher capital and leverage requirements. According to BlackRock, which holds over USD 9 bn. of global infrastructure bonds and loans, the rise in issuance is good news for institutional investors seeking assets that provide them with a steady stream of income over many years. Many infrastructure bonds have maturities of 20 to 30 years, making them particularly attractive to pension funds, insurance companies and sovereign wealth funds with long-term liabilities. Infrastructure bonds that are rated single-A or triple-B have a 4 to 5 percentage point yield, rendering them more attractive than government or A-rated corporate bonds.

Box 6.8
Climate bonds

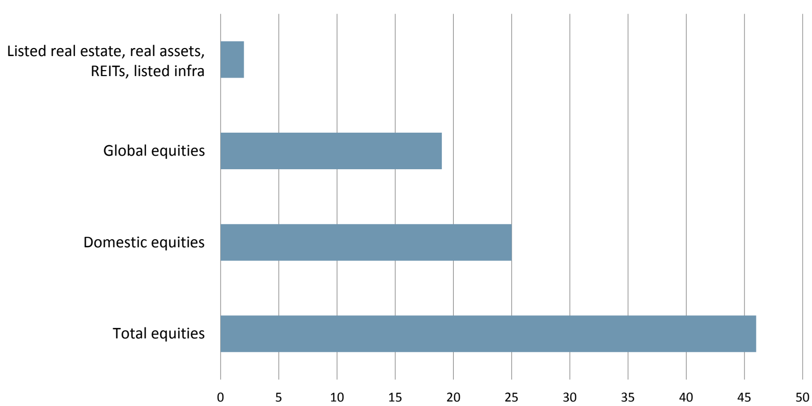
Climate change-linked bonds, related to greenhouse gas emission reduction projects, clean energy generation, energy efficiency, or climate change adaptation projects. The market in green bonds has boomed over the past few years, spurred by growing interest among institutional investors in environmental, social and corporate governance (ESG) issues.

Exchange traded funds (ETF) are an evolving equity growth strategy asset class for pension funds

According to AMP Capital research[14], pension funds and sovereign wealth funds have traditionally allocated investments to public equities, i.e. stocks, making up over 40% of total investments (Figure 6.4). Investments in equities can take on many forms, ranging from picking individual stocks to exchange traded funds, index funds, and registered closed end funds. The allocations tend to be separated in domestic equities, global equities, and listed real assets, real estate investment trusts (REITs) and other.

Index funds. These are open-end funds that attempt to replicate an index, such as the S&P 500, and therefore do not allow the manager to actively choose securities to buy. An index fund's rules of construction clearly identify the type of companies suitable for the fund. Equity index funds include groups of stocks with similar characteristics such as size, value, profitability and/or the geographic location of the underlying companies. A group of stocks may include companies from the United States, Non-US Developed, Emerging Market or Frontier Market countries. Additional index funds within these geographic markets could include indexes of companies that include rules based on company characteristics or risk factors, such as companies that are small, mid-sized, large, small value, large value, small growth, large growth, the level of gross profitability or investment capital, real estate, or indexes based on commodities and fixed-income. Index funds have also been designed to include rules that screen for social and sustainability criteria. Companies are purchased and held within the index fund when they meet the specific index rules or parameters and are sold when they move outside of those rules or parameters.

Figure 6.4
Contributions of equities to the total asset allocation of pension funds



Closed-end funds. Like their better-known open-ended cousins, closed-end funds are usually sponsored by a fund management company which will control how the fund is invested. They begin by soliciting money from long-term and other investors in an initial offering, which may be public or limited. The investors are given shares corresponding to their initial investment. The fund managers pool the money and purchase securities or other assets. What exactly the fund manager can invest in depends on the fund's charter, prospectus and the applicable government regulations, but includes stocks, bonds and alternatives. In the US, a closed-end fund can include unlisted (private) securities including SMEs.

The rationale for a closed-end fund is that the investors do not control how the investment is allocated, the fund management company does. A fund raises its initial equity through the sale of common stock. The amount of equity that belongs to a share of common stock is its net asset value (NAV). As the fund operates, NAV increases with investment gains and decreases with losses. A distinguishing feature of a closed-end fund is the common use of leverage, whereby the fund manager borrows against the invested capital to increase the total amount of investable capital in the fund. The leverage is "cheaper" to acquire than raising more equity from LPs and, hence, an efficient means to increase the size of the fund. The amount of leverage a fund uses is expressed as a percent of total fund assets (e.g. if it has a 25% leverage ratio, that means that for each $100 of total assets under management, $75 is equity and $25 is debt). The objective is to earn a higher return with this additional invested capital.

A distinguishing feature of a closed-end fund is the common use of leverage

Exchange traded fund (ETF) investments. An ETF is a marketable security that tracks an index, a commodity, bonds, or a basket of assets like an index fund. However, unlike mutual funds, an ETF trades like a common stock on a stock exchange, so it has higher liquidity than a mutual fund. Shareholders do not directly own or have any direct claim to the underlying investments in the fund; rather they indirectly own

Box 6.9
Green ETFs

An investment product that focuses on companies supporting or promoting conservation efforts, alternative energy, clean air and water projects and other environmentally responsible business decisions. The majority of green ETFs focus on companies involved directly or indirectly with the research, development, production and provision of alternative energy. Companies may be distributors of alternative energy or may be manufacturers of parts and equipment needed to produce the energy, such as the photovoltaic cells necessary for creating solar panels. Each ETF has its own criteria for determining the eligibility requirements for assets.

these assets. ETF shareholders are entitled to a proportion of the profits, such as earned interest or dividends paid, and they may get a residual value in case the fund is liquidated. The ownership of the fund can easily be bought, sold or transferred in much the same was as shares of stock, since ETF shares are traded on public stock exchanges

Initially marketed as passive instruments – tracking indexes, basically – since 2009 ETFs have shifted towards actively managed investment strategies to optimize returns and minimize volatility. Since pension funds are passive investors, ETFs are an attractive path to accessing new investment options. The contribution of ETFs in pension fund allocations has increased dramatically for over a decade, amounting to 14% of total in 2015. With 5,300 products available – including **green ETFs** – they offer a breadth and depth of investment exposure while becoming cheaper and more liquid, allowing more efficient intra-day pricing and trading.

The contribution of ETFs in pension fund allocations has increased dramatically for over a decade

As institutional investors have become more familiar with the product, it has opened opportunities for other parties, including pension funds. As noted earlier, many pension funds rely on advice from independent consultants and outsourced investment management services that tend to use traditional investment products. However, as the asset allocation discussion shifts towards uncovering excess returns over an index, new investment themes such as industrial renewal funds, and changing perceptions such as pension fund SME investments in the local economy, the opportunity for ETFs and other exchange traded products (ETP) such as MARFs will continue to grow.

Alternative investments provide the upside yield in return for lower liquidity

The alternative asset class is ever-expanding and includes infrastructure debt, hedge funds, private credit, private equity, real estate, and commodities. Investor enthusiasm for alternatives stems from a number of factors, including their interest in earning higher returns, meeting cash requirements, and avoiding market volatility. We will highlight a few assets that are relevant to the MARF.

The infrastructure asset class has come to the forefront as a substitute for – or complement to – fixed-income allocations

Infrastructure financing. Infrastructure has long been among a suite of alternatives to drive returns and diversify a portfolio. Given the record-low yields on bonds, the infrastructure asset class has come to the forefront as a substitute for – or complement to – fixed-income allocations. Not all infrastructure investments or assets are suitable as substitutes for bonds, because of the requirements for stable yields, recession resilience, inflation protection and diversification benefits. As a newer portfolio option, infrastructure does not yet provide historical return data to enable estimation of risk-return characteristics commonly available for more established asset classes. Particularly core infrastructure investments have a stable cash flow stream that is forecastable for at least a decade with a low margin of error.

Box 6.10
Core infrastructure

Infrastructure assets that 1) are located in transparent and consistent regulatory environments, 2) have long-term contracts with credible counterparties and 3) are beyond their demand ramp-up phase. It is attractive because most core infrastructure assets have monopolistic positions in the markets they serve, and demand is often uncorrelated with economic volatility.

Hedge Funds. Hedge funds are alternative speculative investments using pooled funds that may use a number of different strategies in order to earn active return for their investors. The types of investment include arbitraging the value of stocks based on mergers, taking long and short positions on equities, investments in debt and equity of distressed, near-bankrupt companies, and exploitation of mis-pricings in corporate convertible securities, such as convertible bonds, warrants, and convertible preferred stock. Because hedge funds make speculative investments, they tend to carry more risk than the overall market. However, the benefit is that they have low correlations with a traditional portfolio of stocks and bonds, and are thus a good diversifying allocation for pension funds, sovereign wealth funds and endowments.

The typical process most pension plans follow to achieve their hedge fund allocations is based on incremental allocations to increase knowledge of the hedge fund market place. In the second phase the pension fund will invest directly in hedge funds with assistance from a consultant. At this stage of the process, the overwhelming majority of the hedge funds a pension plan will invest in are the largest "brand name" hedge funds with long track records. Performance is of secondary consideration to perceived safety and a reduction of headline risk. In recent years, pension funds have withdrawn allocations because the performance of hedge funds has not justified their cost.

Majority of the hedge funds a pension plan will invest in are the largest "brand names"

Private credit. In an environment where credit is rationed – where banks are constrained to lend – there is capacity for pension funds and institutions to act as intermediaries, as shadow banks. During and after the financial crisis, credit "recovery" strategies involved deploying capital in distressed or oversold markets such as leveraged loans (illiquid credit), high yield bonds, collateralized debt obligations (CDOs), and securitized loans. Specialized allocations to credit may be tactical investments, or part of a longer-term strategic allocation, depending on a fund's view on opportunities. In the current environment, credit opportunities persist through direct lending strategies, where institutional investment funds raise capital to deploy in SME loans and other direct corporate loans.

Liquidity is lower in such strategies, which is why they are considered alternative investments. TheCityUK published a review in 2013 on alternative finance for SMEs and mid-market companies (MMs) in the UK and Europe, and concluded that growth in this space is a means to increase the resilience of the financial system and the wider economy by diversifying the sources of finance to companies. It pointed out that whereas in Europe, banks provide 80% of SME financing, in the US the number is closer to 20%, the remainder being provided by non-banks and capital markets[15].

Given their long-term investment horizon, pension funds, sovereign wealth funds and endowments are comfortable with less-liquid investments, like private credit, that provide offsetting benefits when compared to liquid public market investments. Those benefits include yield premiums, diversification, and structural elements such as traditional financial covenants that help mitigate risks inherent in holding an illiquid investment through maturity. In today's yield-constrained, low-interest-rate environment, institutional investors' demand for this asset class has increased significantly. Private credit investments can be found across the spectrum from traditional, fixed-rate debt private placements, credit tenant loans, and infrastructure debt in the investment-grade world, to senior and junior middle-market loans and mezzanine in the speculative grade category.

Private equity is quickly becoming the attractive third way for pension funds to increase returns

Private equity investments. Large institutional investors are heavily favoring private equity as the alternative-investment strategy of choice. According to Institutional Investor, a financial industry blog, 60% of asset managers plan to increase private equity allocations, whereas 20% planned to do the same with hedge funds. One thing is clear: Private equity is quickly becoming the attractive third way for pension funds to increase returns. The contrasting perceptions of volatility in pub-

Box 6.11
Illiquid Credit

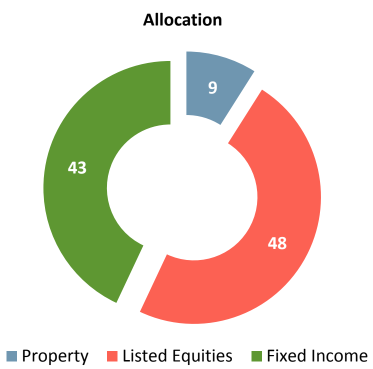
Debt instruments that do not have a functioning secondary market, and are usually held until maturity. Most illiquid assets derive their value almost entirely from their cash flows, rather than a perceived future market appreciation (beta), so are well suited to supporting an institutional investor's stream of liabilities. There are broadly three types of illiquid credit: long-dated, often inflation-linked assets; 5 to 7 year maturity investments; and unique, specialist opportunities that can offer impressive risk-adjusted returns.

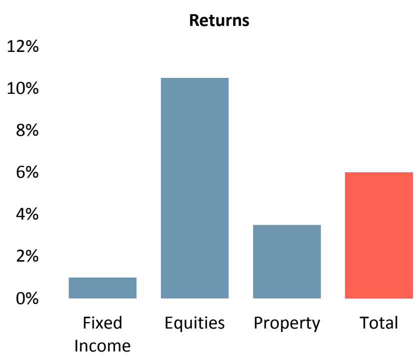
lic and private markets offer a concrete benefit. Whereas the volatility in the public markets is substantial due to emotional reactions driving its movements, private equity isn't subject to the same daily volatility. Its movements in value are not covered by major news outlets, or influenced by retail investors. Funds typically invest over ten-year horizons, while valuations are infrequent and rarely publicized. Paradoxically, the complexity and opacity of the private market benefit pension funds, despite the high-risk nature of its assets.

The hunt for alternative assets: Finnish pension funds follow global trends

A November 2015 entry in Pensions & Investments Europe, an online trade blog, on Finnish asset allocations indicated that some pension funds are planning to increase their exposure to alternative asset classes, particularly to private credit[16]. Based on the distribution in Figure 6.5., listed equities constitute about 50% of AUM, with fixed income on the order of 43%. The remainder is captured under property investments, an alternative asset. The figure demonstrates that equities and property drive returns, which in 2015 amounted to about 6%.

Figure 6.5
Finnish pension fund asset allocation and returns





These values represent averages across Finland's pension funds. For example, the allocation at VER (the State pension fund) deviates from the average, with bonds (49.5%), equities (39.5%) and alternatives (10.6%). The portfolio returned 5.5% overall over the first half of 2015, with alternatives yielding 2.7%. The bond portfolio returned 0.5% and equities 13.3%. Other pension funds such as Verso (the paper industry's fund) have allocated 3% to private equity. The differences between the country's pension funds are largely driven by regulation and liabilities of an aging demographic.

One common theme among the pension funds is their intent to explore expansion into private credit, to meet demand for corporate funding from sources other than banks. The challenge remains that the return from private credit is similar to working capital from bank loans, which won't impact overall portfolio returns. Instead, leveraged credit, structured as part of a MARF, may increase returns from new alpha, namely investment in industry ecosystems. Indeed, some of the nation's pension funds have started to allocate to private credit products such as **illiquid credit** (Box 6.11), but the amounts are still very small. Juuri Partners (Helsinki) is an example of an asset manager engaged in illiquid credit opportunities for SMEs.

The rise of multi-asset funds is driven by investor desire to expand diversification and return opportunities

In recent years, multi-asset funds have been designed to meet investor objectives by integrating multiple asset classes in a single fund. A multi-asset class fund is a combination of asset classes (such as cash, equity or bonds) used as an investment. The weights and types of classes will vary according to the individual investor. The mix of expectations for returns, low volatility and low risk can be met by – for example – structuring closed end funds with longer-term lock-ins. A key challenge is the management of such funds, given the different strategies employed to optimize each asset class and the overall portfolio.

Dozens of fund providers including BlackRock, the world's largest asset manager, Invesco Perpetual and Hermes Investment Management have launched new multi-asset products since 2013, while competing to hire experts with skills in diverse asset allocation strategies. To date, there are 32 multi-asset ETFs in the US alone, attractive to investors seeking instant diversification. Despite the (current) fringe allocation of pension funds to multi-asset ETFs, their structure and performance has shown the opportunity for scaling investment in riskier asset classes with proper diversification across thematic portfolios.

What is behind the rise of multi-asset funds?

Partly, the trend is a product of financial industry soul-searching that followed the financial crisis, when many investors were unimpressed to hear their funds had "beaten" their benchmarks by virtue of losing slightly less money than the underlying index would have done. The real benefit of multi-asset class investments is an increase of the diversification of an overall portfolio by distributing investments throughout several classes. This reduces risk (volatility) compared to holding one class of assets, but might also hinder potential returns.

A decade ago the basic concept of a multi-asset income fund was dramatically different. Multi-asset funds evolved from traditional balanced funds, a mix of equities and bonds; just the basic binary decision between stocks and bonds. How much did you hold of each asset class as

Box 6.12
Tactical Models

An active portfolio strategy that rebalances the percentage of assets held in various categories to take advantage of market pricing anomalies or strong market sectors.

a reflection of your investment strategy? Fund managers were focused on timing the market by combining macro analysis and **tactical models**. Fund managers and the academic literature have experienced that this is exceedingly difficult. In the last few years, multi-asset income funds have moved light years ahead. Today, it is all about managing an increasingly multi-dimensional and much expanded opportunity set of asset classes. That evolution has been argued to be the reason why multi-asset income funds will prove their value relative to other investment strategies in the immediate future.

The real benefit of multi-asset class investments is an increase of the diversification of an overall portfolio

Benefits of multi-asset funds

A first major reason of having an allocation to a multi-asset investment strategy is to maximize the opportunities for compelling risk-adjusted returns by expanding asset class commitments in the context of balanced diversification. This is an important point if we step back to think about it in light of current market sentiment, and the desire for industrial transformation. Despite the recent volatility in the markets, we are now nearly seven years into a bull market in equities, and thirty years into a bond bull market. Many investors are thinking first about yield and return, with less attention on the risk. This is not an optimal solution on a medium term investment basis, and **multi-asset funds help to address this risk**.

A second major reason that multi-asset investment funds are resonating with institutional investors has to do with realizations that they can replace what used to be the low risk part of their portfolios. Given the low yields and high expense ratio, an allocation to a traditional bond today is becoming very unattractive, leaving higher risk assets with greater valuation as the only opportunity for growth. A multi-asset income fund able to incorporate these opportunities while balancing the volatility inherent in higher risk exposures is being seen as a preferable foundation allocation by pension funds.

As can be expected, multi-asset funds are not all roses, because they require active management to rebalance their assets, or to take advantage of specific markets or other conditions. As indicated earlier,

Box 6.13
Diversification

A risk management technique that mixes a wide variety of investments within a portfolio to, on average, yield higher returns and pose a lower risk than any individual investment found within the portfolio. Diversification strives to smooth out unsystematic risk events in a portfolio so that the positive performance of some investments will neutralize the negative performance of others. Therefore, the benefits of diversification will hold only if the securities in the portfolio are not perfectly correlated.

a key challenge for multi-asset funds is the management of each asset class, because of the use of different strategies to maximize return and minimize volatility while taking advantage of the diversification benefits of the fund. According to Reuters, expense ratios for multi-asset funds range from 0.7 to 1.5% of assets under management (AUM). Marketing fees can run up to 0.25%, and commissions or sales charges can amount to 5% of AUM.

Box 6.14
Expense Ratio

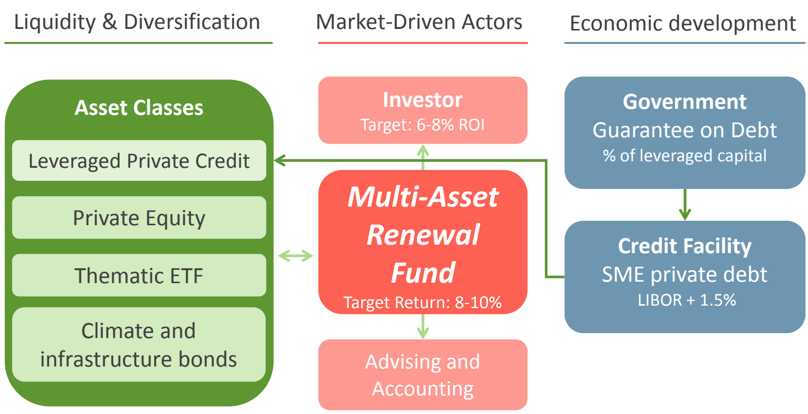
The annual fee that all funds or ETFs charge their shareholders. It is the percentage of assets deducted each fiscal year for fund expenses, including marketing and distribution fees, management fees, administrative fees, operating costs, and all other asset-based costs incurred.

Hence, the costs of multi-asset funds have to be viewed in the context of the returns on the fund. Despite these potential concerns, this has not held back investor allocations to multi-asset funds. According to Morgan Stanley's financial equity research, multi-asset funds are expected to grow to $6.2 trillion by 2018, from about $5 trillion in 2016.

Disrupting economic development: Multi-Asset Renewal Funds (MARF) blend public and private finance at enhanced market returns

Given the appeal of asset risk diversification, asset manager experience with multi-asset funds, and the interest of pension funds to allocate to private credit assets, it should be no surprise that we sought to build our thematic emerging industry investment strategy on the multi-asset model. However – and this is an important distinction – current multi-asset funds are entirely based on liquid assets (stocks, bonds, cash). The MARF's investment strategy needed to be modified to include liquid and illiquid (private credit and private equity) asset classes,

Figure 6.6
Structural elements of a MARF



given that the financial network map – our strategic basis for thematic investment target sourcing – encompasses both public and private enterprises (see Chapter 3).

In the parlor introduced in Chapter 3, a Multi-Asset Renewal Fund leverages existing assets, or anchor industries, in a country or region, and supplements them with innovative companies from catalyst industries that help to grow the emerging industry. Hence, MARFs are an innovation on value chain investing, but with a significant twist: They blend public and private finance (Figure 6.6).

The fund will be structured as a closed end fund, where management will control how the money is invested and allocated across the four asset classes. Two assets are illiquid – leveraged debt and VC/PE, and two asset classes are liquid – thematic ETFs, and corporate climate bonds.

1 The leveraged debt asset is an **active management strategy** to reposition and help grow companies that want to maintain control of the company, or cannot be financed through the traditional financial system. Catalytic public investment by way of first-loss guarantees will be used to de-risk this asset.

2 Investment in the VC/PE asset class will be managed as an LP in portfolio companies of **captive funds**, such that the fund manager has participation rights in follow-on investments. The fund exists solely to provide investment management services to the MARF investors.

3 The thematic ETFs are structured based on companies in industry segments represented by the financial network map, and selected using the **KeyStone Compact® Enterprise** tool. They include a mix of 80% from the 'strategic' and 'expansional' quadrants, and 20% from 'competitive' and 'opportunistic' quadrants, with individual company allocations in the ETF not exceeding 8%. The 80:20 ratio was instituted to diversify the the risk of companies seeking to actively engage and invest in new lines of

Box 6.15
Portfolio guarantees

These guarantees cover a proportion of the losses on the package of loans (or projects) as a whole. A 'first loss' guarantee covers part of the first tranche of losses – for example, 80% of losses up to a value of 10% of the whole portfolio. A 'second loss' guarantee covers a second tranche of losses – for example, 80% of losses between 10% and 30% of the portfolio. First loss guarantees provide greater protection to the investor. Second loss guarantees protect against extreme events while providing strong incentives for the lender to minimize losses as they bear the first tranche. A risk of this model is that the guarantor has limited control over the loans or projects in the portfolio.

business, with those maintaining a conservative corporate strategy in their core markets.

4 The corporate climate bonds are drawn from the **open bond market** based on corporate issuances that are thematic to the emerging industry ecosystem.

As a quick side note to the piqued reader, we will elaborate in detail on the relative allocation of investments among the asset classes and specific companies, the fund's expected performance, and its relative position to other investment vehicles in the following chapter on the MARF's risk assessment.

A blended finance approach is key to engaging economic development in industrial renewal

The blended finance concept and model has been trending over the last year or so, and was developed within the ReDesigning Development Finance Initiative from the World Economic Forum[17]. At its core, the blending of private and government finance seeks to de-risk private investments using first loss guarantees and other instruments. Even though this does not need to be a government agent, the model fits well within economic development mandates. Indeed, the EU, and many of its member governments already have guarantee programs in place to accelerate investment in SMEs and growth enterprises. The rationale is that blended finance delivers, aside from financial returns, derivative benefits such as job creation, industry innovation, and – in the case of environmental projects – sustainability impacts.

Blending of private and government finance seeks to de-risk private investments using first loss guarantees and other instruments

The primary benefit from an investment perspective is that it allows private capital to flow to projects it would normally not invest in, or make risky private credit investments to help companies scale or reposition. The April 23 2016 issue of The Economist reported on the results from a World Economic Forum (WEF) study of 74 blended finance vehicles[18]. For every dollar of public money invested, a further $1–20 was catalyzed in private investment. It is no surprise that policymakers have resorted to blended finance to supplement subsidies and low cost financing to stimulate local economies and execute on visions for industrial renewal. For example, the creation of a European Fund for Strategic Investment (EFSI) – also known as the Juncker plan – aims to stimulate a multiplier effect of 1:15 in real investment in the economy, totaling $436 bn. (350 bn. Euro), by leveraging $26 bn. (21 bn. Euro) in public funds. Most of this investment is aimed at infrastructure and SME investments, for example using Long-Term Investment Funds (LTIF)[19].

According to legal language published by – and approved by – the European Commission in April 2015:

> "The European LTIF will be able to invest in all kind of assets that are not traded on regulated markets. These assets are illiquid and, for that reason alone, require a fund to make a long-term commitment when purchasing them. The same is true for those who invest in such a fund. Assets that are not traded on a secondary market and whose owners would require considerable time in finding a purchaser would comprise the following: (1) Investments in infrastructure projects, such as in the field of transport, energy or education; (2) Investments in unlisted companies, in practice mainly SMEs; (3) investments in real estate assets, such as buildings or direct purchase of an infrastructure asset. [….] Since it is necessary to provide for managerial flexibility with respect to the precise time frame in which a portfolio of long-term assets has to be assembled, the proposal allows for a five-year period during which the portfolio can be built up. In addition, the proposal allows the manager to invest up to 30% of the ELTIF's capital in liquid securities. This liquidity buffer has been conceived to allow the ELTIF to manage the cash flow that arises while the long-term portfolio is being constituted. It also allows the manager to place surplus cash that is achieved 'between investments' – that is when a long-term asset is sold in order to be replaced by another".

The MARF can be viewed as an LTIF focused on industry ecosystem investing for economic development

The MARF is a non-regulated closed end fund with longer holding times because of the illiquid assets in the fund. Even though at this time infrastructure investments are not envisioned in the fund, discussions with global investors, wealth management and insurance companies have indicated that a MARF-type of instrument would (i) be qualified as an 'alternative investment' – asset class that falls outside the traditional definition of listed shares and bonds, and (ii) would be appealing to insurance companies and pension funds with long-term liabilities and an appetite for investing in longer-term investment assets.

How does the MARF relate to existing financing mechanisms in Finland?

Current financing mechanisms (e.g. Tekes, TESI, Finnvera, Sitra) using public or private funds focus on company-specific investments, either as private equity, loans or grant programs. Aside from equity finance, the returns are based on bank interest rates. The MARF focuses on the value chain, a financial integration of multiple asset classes intended to engage pension funds and wealth management investors by offering attractive returns while driving economic development. Fundamentally, it is a market-driven investment instrument that integrates components of existing financing mechanisms, except for grants.

How much more effective is the MARF in the use of public funds for output and employment as compared to existing financing schemes?

One of the key arguments for the deployment of a MARF is the economy of scale embedded in the financing instrument, the **direct** public funding leverage ratio, and the financial leveraging ratio. Given the type of investor that is targeted, the capital deployment needs to adhere to diversified investment objectives, with risk and return profiles typically associated with alternative assets, while adhering to portfolio liquidity. The Global CleanTech Cluster Association, in an article on cluster investment in Environmental Finance[20], showed that 3 to 40 jobs were created per company from investments in the range of $3–35M. On the other hand, investments in clusters of 50–200 companies, a proxy for MARFs, were upwards of $200M. and generated 130–3,000 jobs. The projected efficiency gain from the economies of scale through MARF investments is a factor of 2–3. This does not take into account the output and employment from MARF infrastructure projects.

What is the deployment track record of the MARF approach?

The MARF design approach to thematic investing has been tested and iterated with investors at Deutsche Bank Wealth Management (London), HSBC Global Debt and Alternative Investments (London), KBC Wealth Management (Brussels), the P80 Foundation (representing 80 of the World's largest pension funds), CIOs and Directors of Alternative Assets from Finnish pension funds and banks (e.g. Elo, Ilmarinen, OP, VER), and Government Investors. Currently, four commercial MARF designs are under development: (I) Bio-based chemistries (Antwerp-Ruhr-Rhein Chemical megacluster), (II) Smart Mobility industry (Switzerland), (III) British Columbia (Canada), and (IV) Taiwan Green Trade Office. It is expected that three MARFs will be designed under the Tekes-funded FiDiPro project (Smart Grid, Smart Mobility, and Bioeconomy) that this book is an integral part of.

What is the financial performance of a MARF?

Portfolio performance of MARF-type instruments is dependent on the deal sourcing of companies from the emerging industry ecosystem (Chapter 3), the risk analytics of the underlying assets (Chapter 4), the chosen asset allocation strategy (Chapter 5), and the asset class structuring in the blended finance vehicle (Chapter 6). Chapter 7 will discuss in detail the performance of a fund based on companies selected for the Smart Mobility industry. The performance metrics of this fund need to meet the 6–8% net return target required by investors, at a long-term risk similar to and not significantly exceeding the bond-stock profile.

References

1 KPMG (2014). Luxembourg Regulated Investment Vehicles: An overview of the legal and regulatory requirements. Available at https://www.kpmg.com/LU/en/IssuesAndInsights/Articlespublications/Documents/Regulated-Investment-Vehicles-2014.pdf. Accessed 04172016.

2 Mezzacapo, S. (2009). The So-Called "Sovereign Wealth Funds": Regulatory Issues, Financial Stability, and Prudential Supervision. European Economy, Paper 378. European Commission, Directorate-General for Economic and Financial Affairs, Brussels, Belgium.

3 Zingales, L. (2015). Does Finance Benefit Society? Chicago Booth Research Paper No. 15-09. Available at SSRN: http://ssrn.com/abstract=2585194.

4 Foroohar, R. (2016). Makers and Takers: The Rise of Finance and the Fall of American Business. Penguin Random House LLC, New York.

5 Van der Zwan, N., McCarthy, M. & Sorsa, V.-P. (2015). Pension Fund Capitalism and Financialization: The United States, the Netherlands and Finland Compared. Conference Paper, Inequality in the 21st Century, Society for the Advancement of Socio-Economics, London, UK.

6 Van der Zwan, N. (2014). Making sense of financialization. Socioecon. Rev. 12 (1): 99_129.

7 Macheda, M. (2012). The role of pension funds in the financialization of the Icelandic economy. Capital & Class 36 (3): pp. 433–473.

8 Jung, R. G. & Rhee, N. (2013). How Do Public Pensions Invest? A Primer. Report from the National Institute on Retirement Security, Washington, DC.

9 Global Subsidies Initiative. Geneva, Switzerland. Available at https://www.iisd.org/gsi/effects-subsidies.

10 International Chamber of Commerce (2012). Green Economy Roadmap: A guide for business, policy makers and society to drive sustainable growth in a resource-constrained world with strong demographic growth. Available at http://www.iccwbo.org/products-and-services/trade-facilitation/green-economy-roadmap/, Accessed 05142016.

11 Della Croce, R., Kaminker, C. & Stewart, F. (2011). The Role of Pension Funds in Financing Green Growth Initiatives", OECD Publishing, Paris.

12 Massie, R. (2016). Welcome to the ESG Evolution. Institutional Investor, Available at http://www.institutionalinvestor.com/article/3535562/investors-pensions/welcome-to-the-esg-evolution.html#/.V0R4nJMrL6A, Accessed 04262016.

13 Deutsche Asset and Wealth Management (2015). ESG & Corporate Financial Performance: Mapping the global landscape.

14 AMP Capital (2015). Institutional Investor Report. Available at https://www.ampcapital.com/campaign/iir, Accessed 10222015.

15 TheCityUK (2013). Alternative Finance for SMEs and Mid-Market Companies. London.

16 Paakinen, R. I. (2015). Finland Asset Allocation: The hunt for alternatives. Pension & Investments Europe, November 2015. Available at http://www.ipe.com/pensions/pensions-in/nordic-region/finland-asset-allocation-the-hunt-for-alternatives/10010454.fullarticle, Accessed 05022016.

17 World Economic Forum (2015). Redesigning Development Finance. Available at https://www.weforum.org/global-challenges/projects/redesigning-development-finance/, Accessed 05192016

18 The Economist (2016). Trending: blending. Apr 23rd 2016.

19 The European Long Term Investment Fund (2015). Available at http://ec.europa.eu/finance/investment/long-term/index_en.htm, Accessed 11022016.

20 Adriaens, P., Lesser, S. & Taube, B. (2012). CleanTech Clusters – Scaling Local Economic Development for Global Investment. Environmental Finance (February issue).

7

Risk: Return Assessment

MARFs Provide Enhanced Returns at Moderate Risk Increases

MARFs Provide Enhanced Returns at Moderate Risk Increases

> *We have no future because our present is too volatile.*
> *We have only risk management.*
> *The spinning of the given moment's scenarios.*
> *Pattern recognition.*
>
> – William Gibson, Author

Risk rating as the basis for performance assessment and optimization

In the previous chapter we arrived at the actual fund structure for the MARF. We established the various asset classes that constitute it and how companies are sourced and allocated accordingly. The final stage in the design process is a performance test. At the end of the day, the most crucial of questions concerning any new instrument is: Does it work?

To this end, we first develop a risk-rating strategy for Multi-Asset Renewal Funds (MARF) in general. Then, we test it using a specific fund structure, focusing on the Smart Mobility industry as the empirical testbed.

Briefly, the fund is comprised of four asset classes; SME private debt (credit), private equity (or venture capital), public equity (ETFs), and climate bonds (or infrastructure bonds, if available). To develop and test a risk rating strategy, it is necessary to incorporate details on the risks and return expectations of all sub-assets and companies that were selected for inclusion in the MARF.

You will remember from Chapters 5 and 6, that we arrived at this stage by applying a rules-based risk tiering strategy to incorporate non-financial and financial risk metrics for each private company, which was then used to assign the respective firms to the debt, equity, and 'ETF' asset classes of the MARF. The universe of private companies is listed in Figure 5.15. In this chapter, we will additionally detail the universe of stocks and bonds to complement the MARF asset allocation for one type of fund. To assess the performance of a Multi-Asset Renewal Fund in general, and the Smart Mobility MARF in particular, it is necessary to:

1 Develop a risk rating strategy for each asset class separately, and integrate the risk and return profile across all asset classes;

2 Apply the rating approach using a pre-specified allocation and portfolio structure, to understand the contributions of each asset class;

3 Test the impact of default and asset correlation assumptions on the volatility of the fund performance;

4 Optimize the asset allocation within and between asset classes, to develop a spectrum of risk:return profiles relevant for institutional investors.

Due to the illiquid nature of **private debt** and **private equity**, we will describe an approach that involves the use of financial data for comparable public companies that are used as proxies for the private companies in both asset classes. By applying the 'comparables methodology', it was possible to apply the Capital Asset Pricing Model (CAPM) to estimate returns and volatility for the private company as if it were a public company. Naturally, we needed to incorporate liquidity discounts – as will be detailed later.

Box 7.1
Capital Asset Pricing Model (CAPM)
An empirical model used to determine a theoretically appropriate required rate of return of an asset, if that asset is to be added to an already well-diversified portfolio.

In the case of **SME debt**, the probability of default for each company is calculated, a liquidity premium due to the private nature and size of the debt is added, and the probability of default is compared with public bonds in the European market. For **public equities** we use the actual returns from a specified Smart Mobility Index of companies to calculate standard deviation and volatility. **Climate bond** analysis is conducted on qualifying bonds in the global marketplace, by calculating the one-month historical yield to worst and applied an equal weight.

A Monte Carlo analysis of these input data allows us to calculate a volatility risk for the MARF portfolio, using historical returns by exploring the correlation between the asset classes, and the individual assets in each asset class. The computational analysis does not explicitly include the impact of government first loss mechanisms – i.e. guarantees – used to underwrite the SME debt instruments, as indicated in Chapter 6.

A Monte Carlo analysis of these input data allows us to calculate a volatility risk for the MARF portfolio

Let us now take a step back and walk you through the process from the very beginning.

Value at Risk (VaR) analytics chosen to integrate risk rating of a Multi-Asset Renewal Fund

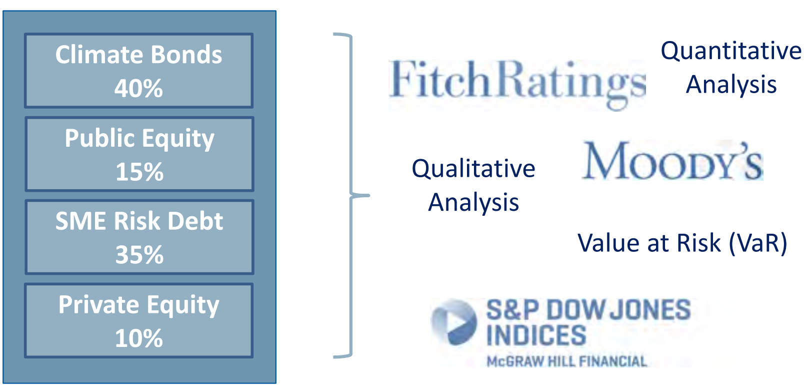
As indicated in Chapter 6, one of the challenges for pension funds and other long-term institutional investors to more broadly allocate capital to green growth is the lack of scalable investment vehicles with appropriate market liquidity. The Multi-Asset Renewal Fund – an innovation on value chain investing – was designed with scale and liquidity that fits investment strategies of pension funds and other long-term investors.

We needed to identify a risk-rating approach for the MARF that pension fund managers would already be familiar with

With this goal in mind, we needed to identify a risk-rating approach for the MARF that pension fund managers would already be familiar with and could readily integrate into their existing risk management and actuarial processes. In addition, the selected metric needed to be applicable to all of the assets that comprise the fund. This is a necessary constraint, partly because the fund is comprised of liquid and illiquid assets, and partly because of the fundamental differences in capital structure across the asset types[1]. These complications – and how they impacted the selection of a risk metric – are detailed within each individual asset class section. We explored risk rating strategies for funds as used by Fitch, Moody's, S&P and Morningstar, that include both quantitative and qualitative analysis (Figure 7.1).

As expected, most of the published models such as the Barra Equity Risk Model and the Northfield Factor Model focus on public equities (including ETFs), listed bonds and infrastructure or real estate companies, as well as funds based on these asset classes and sub-classes. These fundamental (i.e. based on publicly available financial data) and stochastic (uncertainty-driven estimations) models are based on the premise that most securities are correlated with the general market,

Figure 7.1
Approach to MARF risk rating strategy



and are related to the general market by way of a financial beta. The beta is based on the Capital Asset Pricing Model (CAPM), and describes whether a security is more or less volatile than the broader market and whether it follows the broader trends of market direction.

These models also acknowledge that some groups of securities have covariances that are not directly related to the financial beta, but can be explained by both financial and industry-specific metrics. Generally, both systemic (broader market) and idiosyncratic (specific to a company or industry) risks are taken into account. The problem is that – in the case of the MARF – there are two asset classes that are not liquid or not traded on a daily basis on the market. The implication is that we generally do not know what their volatility is relative to market behavior, and whether these assets are correlated at all. We stated in Chapter 6 that – generally – diversification in portfolios has the benefit of uncorrelated assets which may reduce the overall volatility of the fund, and increase its performance. The current chapter seeks to investigate the extent of the diversification benefits in a MARF, and how these can be exploited to generate additional alpha (excess returns over an index).

How do we integrate the risk of illiquid asset classes with those of the public equities?

We selected the Value at Risk framework (VaR) to assess the risk of the fund because of its ubiquitous use within the financial services industry, its flexibility to capture the nuances of each asset type, and its ability to integrate all asset classes into a single rating for the whole fund[2]. Further, it is a very intuitive metric to understand. Simply stated, VaR is the expected loss that will occur with a chosen probability of loss (e.g. 5%, 0.5%). The fundamental inputs to the VaR analysis are historical returns and expected returns[3]. VaR was initially developed by banks to gain a quantitative understanding of their (short term) risk exposures, or extreme losses. Over the last decade or so, VaR has become embraced by an ever-increasing number of companies who use it as their chosen method to develop enterprise-wide risk management approaches. The trend of increased use is clearly facilitated by the fact that VaR is easily understood by non-specialists.

Box 7.2
Value at risk (VaR)

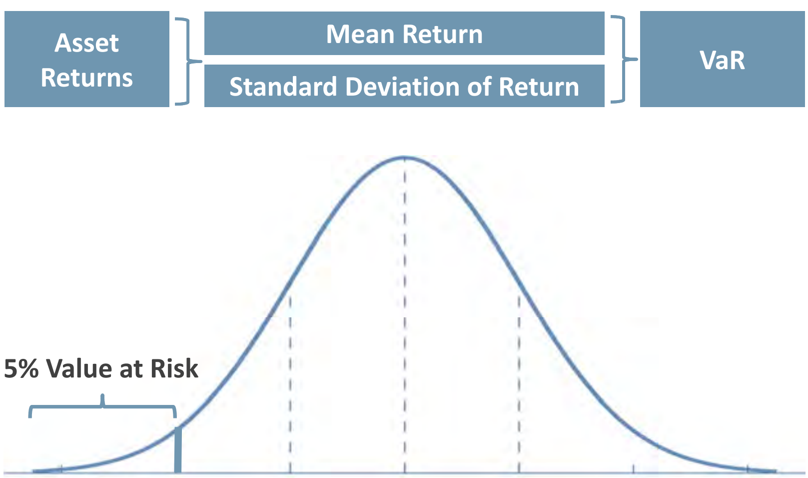
A statistical technique used to measure and quantify the level of financial risk within a firm or investment portfolio over a specific time frame. Value at risk is used by risk managers in order to measure and control the level of risk which the firm undertakes.

It should be noted that with simplicity comes risk of overreliance on the metric. Indeed, the embedded risk associated with VaR estimates is that they are based on past data, i.e., they use the historical distribution of outcomes of the investment. However, to evaluate the risk of an investment, it is of no interest how large this risk has been in the past, but rather how much risk there is within the time horizon going forward. Hence, the future distribution of outcomes would be relevant to consider. As long as the distribution of outcomes remains stable, i.e., does not change over time, the VaR can be deducted from a historical distribution of returns. In reality, the distributions are not stable over time; most notably, the variance of outcomes and the correlations between assets and asset classes changes. Hence, relying solely on historical data can therefore give an inadequate risk measure. We considered this risk for the MARF (a long-term investment instrument with market liquidity) as we took into account 10-year time series of data (except for climate bonds) in our estimates. Only normal or log-normal distributions of returns or defaults are reasonable for VaR estimates and forecasts (see later).

Since 2007, the assumption of normal distributions has become insufficient

Since 2007, the assumption of normal distributions has become insufficient, since 'black swan' events tend to cause havoc in the financial markets, resulting in a potential domino effect. As extreme events causing very large losses are rare, they are in most cases not included in the data. Hence, the VaR estimate gives only a risk assessment of the investment under "normal" market conditions, and extreme events like a stock market crash are not included. After discussions with our stakeholders, we decided that we needed to address the issue of extreme events, given that the correlations between assets in most of such cases tend to increase significantly. Increased correlation between assets and asset classes does not allow for the diversification effect to work as anticipated, and thus we need to account for that situation. To incorporate the impact of extreme losses, our VaR analysis was complemented by a stress test of the MARF portfolio, by assuming a worst-case scenario where all assets are correlated. This

Figure 7.2
Integration of Value-at-Risk (VaR) in MARF risk assessment



approach enables risk managers at investment funds to include such events in their overall risk assessment.

Measuring risk and return for private equity allocations in the MARF

Private equity (PE) investments in privately-held companies are made through a fund organized as a limited partnership[4]. Typically, the limited partners (LPs) consist of institutional and high net worth investors who invest in a closed-end fund managed by a General Partner (GP). As a closed-end fund, investors cannot redeem their shares until the fund liquidates[5], a typical lifespan being between 10 and 13 years. Investment strategies include venture capital, which invest in early-stage high growth companies, and buyout funds, which invest in mature companies, typically through the use of extensive leverage (taking on debt financing).

The GP of the fund is responsible for the investments in and liquidations of individual companies (called portfolio companies) as well as for portfolio oversight. The goal of the fund manager is to maximize returns to investors by investing in private companies and subsequently realizing returns through an 'exit' transaction[5], which can take on various forms, including an initial public offering (IPO) or strategic sale to a third-party. In return, the fund manager receives two forms of compensation: (1) management fees – guaranteed compensation paid directly by LPs to the GP and usually calculated based on a percentage (typically 1–2%) of committed or invested capital[6]; (2) carried interest – a form of performance fee which is not guaranteed to the GP, but is paid out once the fund achieves a return in excess of a specified hurdle rate. Once the hurdle rate is crossed, the GP is entitled to a percentage (typically ~20%) of net profits in excess of the hurdle rate.

In the case of the MARF, the fund manager is the LP for the private equity investment. Hence, the MARF plays an active role in deciding which deals to invest in and typically pays reduced management fees and carried interest to the GP[7]. A study of direct investment programs, including returns data from 1991 through 2011, found evidence suggesting that co-investments by LPs tend to underperform the investments of the corresponding PE funds in which they co-invest. Fang et al.[7] posited that the underperformance could be driven by selection. This means that institutional investors can only select from a pool of companies

Box 7.3
MARF investments in PE

In a typical private equity investment structure, the LP is invested in the entire fund portfolio. In the situation of the MARF, the fund's GP has complete discretion as to the choice of portfolio companies in which the LP's capital is to be invested. Alternatively, an LP can invest directly in a transaction that is originated by a fund manager, which is known as a co-investment.

that the fund manager has made available as co-invest opportunities. These available opportunities tend to be substantially larger deals, which have been shown to have lower returns, and are more likely to have been made during sub-optimal investment periods (i.e. market peaks) where the valuations were relatively high.

Private equity investing has key distinctions that separate it from investing in other asset classes

Based on these unique features, Invest Europe (formerly the European Private Equity and Venture Capital Association) has identified four categories of risks that LP's should consider in a private equity investment evaluation: funding risk, liquidity risk, market risk and capital risk[8].

Funding Risk. Private equity investors do not actually contribute capital at inception of a fund, rather an investment period is determined during which the GP can periodically 'call' capital as needed, in an amount not to exceed the LPs' original commitments[6]. In other words, by 'committing capital,' an investor is contractually obligated to provide the partnership with funding at the request of the fund manager; however, the investor will not know the timing or amounts of calls until the fund manager sends out capital call notices. An LP who cannot meet a capital call requirement could effectively lose a portion of his share in the PE fund. This uncertainty surrounding the timing and amounts of cash flows creates funding risk for the limited partners.

Incorporating PE-specific risks has been quite challenging for academics and practitioners alike

Liquidity Risk. There exists a secondary market for LPs to sell interests in a PE fund. However, the market is highly fragmented and inefficient given the lack of any centralized exchanges[8]. This illiquidity exposes investors to the risk that they may be forced to sell their interests well below fair value, especially when selling due to externally distressing circumstances.

Market Risk. Fluctuations in the overall markets can impact the value of portfolio investments. This issue is further complicated by the impact of stale pricing and lagged returns, which will be discussed later in this chapter.

Capital Risk. The actual realization of value during the exit of a portfolio company, whether it be through IPO or strategic sale, can be adversely impacted by a number of outside factors such as the quality and skill of the PE fund manager or unfavorable movements in exchange rates.

Incorporating PE-specific risks into a systematic approach of measuring the riskiness of these investments has been quite challenging for academics and practitioners alike. According to Ang and Sorenson[4], there are two main problems in assessing PE risk and return. The first is that PE returns are observed very infrequently due to the fact that portfolio companies held by PE funds are not actively traded on an exchange, which makes it difficult to implement traditional finance theory concepts such as CAPM alphas and betas. The second issue relates to the difficulty in interpreting results from traditional finance theory because the assumptions underlying standard asset-pricing models (i.e. transparency, liquidity and low-frictions) do not hold in the realm of private equity.

Traditional finance techniques employed for asset classes such as publicly traded equities involve estimating alphas and betas using an expected return regression, and a CAPM-type financial asset pricing model. Private equity returns are complicated by the fact that there are very few data points where observed market prices actually exist. These data points are typically limited to (1) the initial purchase of the portfolio company, (2) any subsequent rounds of financing that may or may not occur, and (3) the final exit transaction. With the introduction of ASC 820 (formerly FAS 157), Disclosure Requirements for Fair Value Measurement in September 2006[9], private equity fund managers are required to periodically mark their portfolios to fair market value, usually on an annual basis. However, many fund managers do so on a quarterly basis. Because of the lack of availability of observed prices, fund managers have considerable flexibility in deciding what "fair value" actually is.

Fund managers have considerable flexibility in deciding what "fair value" actually is

This flexibility in valuing portfolios has been found to lead to a '**stale pricing**' problem, where valuations are kept at cost for multiple periods until some sort of value realization event occurs, such as a financing or exit transaction. This stale pricing tends to understate the true volatility of private equity portfolios, as well as decrease their correlations with the overall markets[10]. Private equity returns therefore tend to exhibit serial correlations, meaning that prior period returns influence subsequent period returns. This impact is statistically significant for up to four lagged quarters[9]. Further, Anson[11, 12] also found that fund managers exhibit behavioral tendencies. These include that fund managers were more likely to mark their portfolios down quickly in down-markets and slower to write their portfolios up in up-markets, presumably due to a desire to demonstrate conservativism to LPs in the valuation of companies.

Complicating the returns issue is the lack of quality historical data

Further complicating the returns issue is the lack of quality historical data. Databases that compile PE returns exist, however academic research suggests that data quality could be flawed by the fact that many of these databases include self-reported returns data from the fund managers themselves. This suggests that self-reporting biases could exist, in other words, better-performing fund returns are overrepresented in the data because fund managers are more likely to choose not to report poor performance[4].

Existing PE risk models emphasize Net Asset Value (NAV) or cash flow modeling approaches

A survey of academic literature shows that there have been numerous attempts to develop models to measure the risk and return of PE. According to Scarpati and Ng[13], an overwhelming majority of this research has been designed to assess realized returns and risk on an ex post basis, instead of estimating an ex ante risk premium. We note there have been approaches focused on risk-premium predicting models[14], however such models have been developed from the perspective of an investor who is fully invested as a limited partner within a PE fund or portfolio of PE funds – as opposed to an investor who is directly investing on a co-investment basis as in the case of the MARF. Further, these models rely on advanced and unproven statistical techniques. Such risk models have yet to gain widespread acceptance in the private equity space, likely due to their complexity.

The EVCA Risk Measurement Guidelines[8] outline two practical frameworks intended to be implemented at the fund-level by private equity limited partners in their assessment of private equity risks within their portfolios. Both approaches focus on the Value-at-Risk (VaR) metric for assessment of risk:

NAV-time series-based modeling approach. The technique attempts to replicate the methodology used for publicly traded assets by measuring the volatility of a fund's Net Asset Value (NAV) over a specified time period[8]. The model measures the volatility of the periodic reported NAVs of a fund adjusted for capital contributions and distributions during the period. The model is most suitable for investors with a limited allocation to private equity within their portfolios[8].

Cash flow-volatility-based modeling approach. The cash flow-volatility model uses fund level cash flow projections (i.e. capital contributions and redemptions to/from limited partners) over the life of the fund to derive an Net Present Value (NPV) under different scenarios[8]. Using a large number of these portfolio cash flow projections, a probability distribution can be created in order to calculate the VaR.

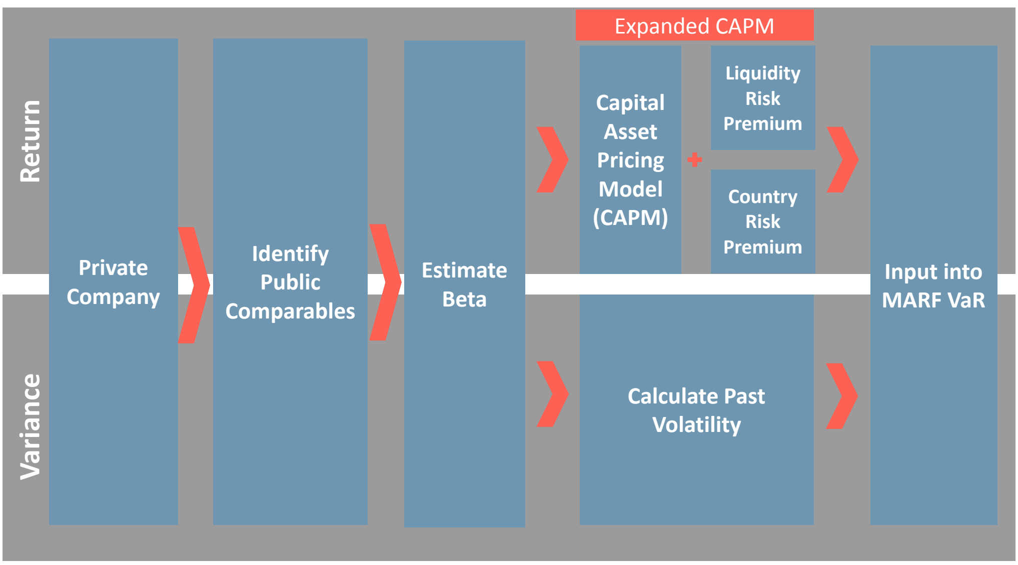
Through our discussions with PE managers, we have found that the risk assessment process in private equity is almost entirely qualitative, rather than quantitative. For instance, a PE investment's risk would be measured by assessing factors such as the expertise of the fund manager or the returns achieved on a fund manager's prior funds. Typically, these qualitative factors will help an investor make informed investment allocation decisions. We have alluded to the use of non-financial and financial risk metrics in the asset allocation discussion in Chapter 5.

We have found that the risk assessment process in private equity is almost entirely qualitative, rather than quantitative

The MARF risk rating methodology for PE portfolio firms is based on best-fit comparables analysis

Given that the MARF will be investing in private equity portfolio companies on a co-investment basis, fund-level models such as the NAV-time series and cash flow-volatility based approach cannot be practically applied. Hence, a risk measurement approach using public company comparable analysis is more suitable for the MARF, similar to the approach used by Ljungqvist & Richardson[15]. The overall concept of the approach is to use the returns of a subset of publicly-traded companies, in a similar industry as the private company, to estimate the return on an illiquid private equity investment. This approach measures risk and return at the portfolio company-level and will largely avoid the issues and biases in measuring private equity returns at the fund-level (Figure 7.3).

Figure 7.3
Overview of the risk rating methodology for PE firms

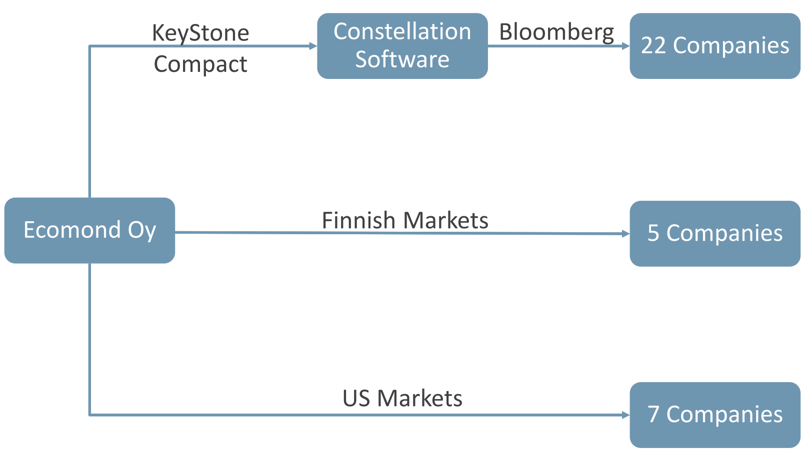


The public comparables approach can be summarized into six steps: identifying public company comparables, estimating beta, calculating volatility, calculating returns, and calculating VaR. A check was also performed to ensure that calculated risk and returns were reasonable, by comparing the data to historical Finnish equity market data. The starting point for identifying a pool of public company comparables was based on the public proxy identified by the KeyStone Compact® analytical tool, which performs a qualitative analysis of a company's operating model. Using the KeyStone public proxy, a larger set of public comparables can be generated from Factset databases using industry and sub-industry codes.

Selecting Comparables. To narrow down the set of public company comparables, a regression analysis was conducted between selected fundamentals (i.e. revenues, EBIT, and EBITDA) of those public companies and our private portfolio company's operating metrics, to determine the extent of any correlations in operations. These correlations help to determine which of the public companies' business operations are substantially similar to our private company. Selecting public companies (Figure 7. 4) with higher correlations will give us a smaller subset of what we will term **'best fit' comparables**.

The premise supporting this conclusion is that external macroeconomic conditions should have the same directional impact on operating financial results for companies operating within the same industry. For example, we would expect a rise in oil prices from one period to the next to uniformly deteriorate the earnings of airline companies who are dependent on using oil for fuel, assuming all other conditions being equal. Therefore, if we can identify public companies with higher

Figure 7.4
Example of comparables selection for Ecomond Oy



correlations in earnings patterns to our private company, we believe it is reasonable to conclude that these public companies are more suitable to be used as a proxy for our private company.

Estimating Beta. Beta is a measure of systematic risk capturing the aspects of investment risk that cannot be eliminated by diversification (16). It evaluates ex post the degree of risk undertaken in a diversified investment program in relation to a specific benchmark, also referred as the market. An expression used for calculating beta is:

$$\beta = \frac{Cov(r_a, r_b)}{Var(r_b)}$$

where: r_a is the return for the asset and r_b is the return of the benchmark.

In general, a beta higher than 1 indicates that the asset is more volatile than the market and a beta lower than 1 indicates that the asset is less volatile than the market.

Once 'best fit' public comparables are selected, we use those comparables to estimate a beta specific to our private company; a concept described by[17] as **bottom-up betas**. Beta is an input into the capital asset pricing model (CAPM), which will be discussed further in the next section, and is a widely-used measure of the volatility of a security in comparison to the market as a whole (Figure 7.5).

Betas for an asset are typically calculated by regressing historical returns against a stock index, with the slope of the regression line representing beta[18]. In the case of private companies, we do not have historical returns data, however we can estimate a private firm's beta by using the average betas of the best fit public comparables previously identified, which do have readily available historical prices. We extracted betas for our best-fit public comparables from Bloomberg, however we note there may be small differences in betas from different sources, due to the timeframes and frequency of data points used in the regressions.

Box 7.4
Unlevered beta

This represents the volatility risk of the company relative to the market, if it does not hold any debt. It is a measure of how much systematic risk a firm's equity has, and removes the beneficial effects from debt.

The use of financial leverage ('debt') magnifies returns and will therefore, exaggerate betas. In order to use the betas we derived from the Bloomberg database, we need to account for differences in financial leverage ('debt') across the individual public companies, as well as our private companies. To accomplish this, we calculated what are known as '**unlevered betas**' for the public comparables. Unlevered betas remove the effects of any leverage in a firm's capital structure. In other words, an unlevered beta is the beta the company would have if it were it financed completely by equity and had no debt. The following formula is used to unlever beta:

$$\beta_{unlevered} = \beta_{levered} / (1 + (1\text{-}T_c)(debt/equity))$$

where: (debt/equity) = the debt-to-equity ratio using market values,

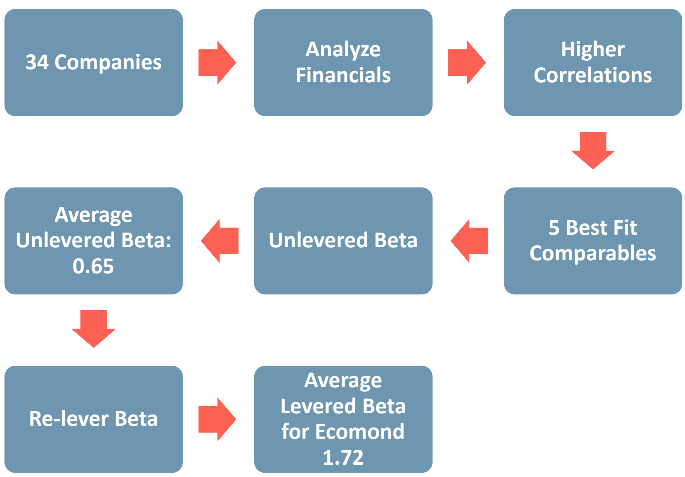
T_c = Corporate tax rate.

Once we unlever the betas for all of the best-fit public comparables in our set, we can calculate a simple average of that set, which represents the **unlevered beta of our private company**. The next step is to relever the private company's unlevered beta according to the target capital structure of the private company. This can present a complication in that we do not have the market values of debt and equity for private companies like we did for public companies. Some analysts will just use book values. An alternative methodology is to use the average debt-to-equity (D:E) ratio of the public companies constituting the comparable set[17]. In our analysis, we have judgmentally applied both methodologies to evaluate the use of one versus the other to provide better quality data. The following formula was used to relever beta:

$$\beta_{private\ firm} = \beta_{unlevered} (1 + (1 - T_c)(Comparables\ Average\ Debt/Equity))$$

Calculating Volatility. Using the estimated betas from our comparables analysis it is possible to estimate past volatility for the portfolio of private equity investments. By multiplying the beta to each weekly return

Figure 7.5
Approach to determining the behavior of Ecomond Oy relative to market comparables



of the HEX index we designed a series of past returns for the target company which we used to calculate past volatility. From Figure 7.6 it is possible to see what the volatility would look like as compared to the benchmark for one specific company we analyzed, Ecomond Oy.

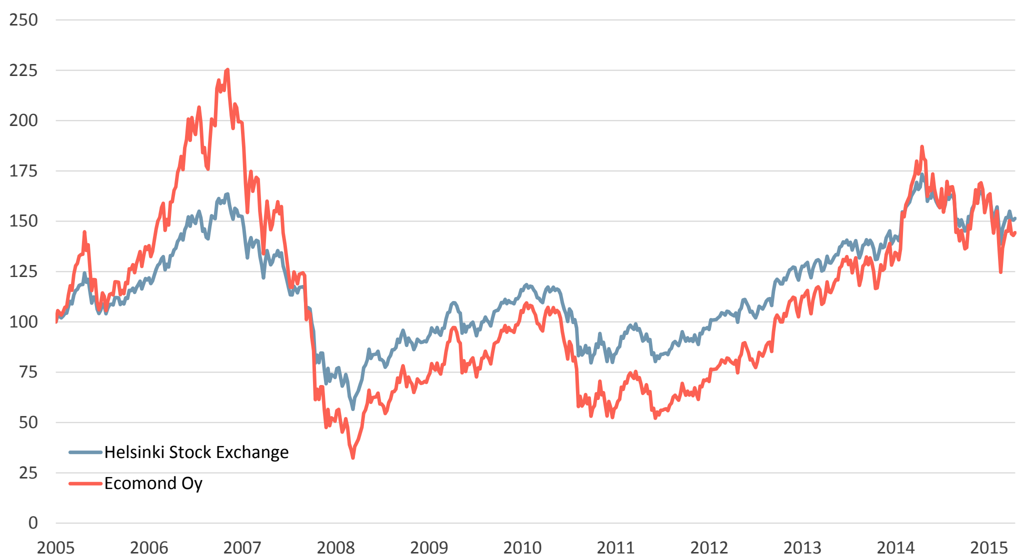
Calculating Returns. Using the estimated betas from our comparables analysis, along with risk free rates and equity market risk premium inputs, we can estimate returns for the portfolio of private equity investments using the Capital Asset Pricing Model (CAPM). This is a single-factor model that can be used to describe the relationship between risk and expected return on an asset or a portfolio of assets. It is generally represented by the following equation:

$$\textit{Expected Return} = \textit{Risk free Rate} + \beta_{asset}\ (\textit{Risk Premium on Market Portfolio})$$

where: risk premium on market portfolio = (expected return of market – risk-free rate).

The CAPM makes the assumption that there are no transaction costs, illiquidity or private information, assumptions that do not hold within the realm of private equity. In order to account for these private equity-specific features, we build in risk premiums designed to capture the excess risks associated with private equity investing. Our expanded CAPM formula will include risk premium adjustments for liquidity risk and country risk according to the following formula:

Figure 7.6
Estimated returns for Ecomond Oy using comparables methodology



$$E[R] = R_f + \beta_{asset}\ (Risk\ Premium\ on\ Market\ Portfolio + LRP + CRP)$$

where: LRP = Liquidity Risk Premium, CRP = Country Risk Premium.

In the following sections we will discuss the remaining inputs, excluding beta which was previously discussed, into our CAPM formula.

Risk-Free Rate of Return. CAPM starts with the risk free rate, which is defined as the rate of return an investor would receive if they were to invest in an asset where actual returns are always equal to the expected returns[18]. In mature markets, as is the case in Finland, using 10-year bond rates to approximate the risk-free rate is a generally accepted practice[18]. As such, we have used the 10-year Finnish sovereign bond rate in our analysis, which was 0.41% in April 2016.

Equity Market Risk Premium. The equity market risk premium ("ERP") can be defined as the additional return an investor demands for investing in a broad spectrum of equities as a class over the risk free rate of return[19]. Equity risk premiums are determined by many factors, including the current state of risk aversion in the markets, the health of the economy, precision of information in the markets, and government policy. Given the wide array of factors that can influence ERPs, a precise measurement of the ERP at any given time is quite challenging. There are three broad approaches used in estimating ERP's, each with their own advantages and limitations: surveying subsets of investors and managers, using historical returns on equities relative to risk free assets, and estimating a forward-looking premium based on current market prices (also known as an implied premium).

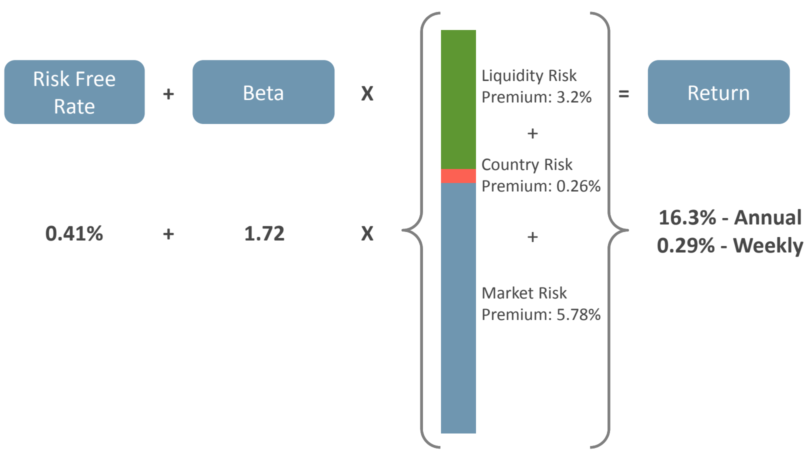
For the purposes of this analysis, we used a survey conducted by PwC in 2015 as the basis for ERP. PwC surveyed Finnish investors, equity researchers, insurance companies, and other professionals and found an average estimate of the ERP in Finland of 5.78% (PWC 2015). We also reviewed independent academic research commonly used as a primary resource for ERP measures, noting that an ERP of 5.75% was estimated as of January 2015 for the US[19]. Given that Finland is a mature market environment, similar to the US, it is reasonable to use the PwC survey results as a measure of ERP in Finland (see integration of ERP in PE risk and return exemplified for Ecomond Oy in Figure 7.7).

Liquidity Risk Premium. Damodaran[20] describes the cost of illiquidity as buyer's remorse; sometimes an investor will reverse a purchase decision, and will want to sell an asset that was just bought. The cost of illiquidity is the cost of that buyer's remorse. In other words, if the investor were to attempt to sell that asset immediately, more than likely a loss would be incurred. For publicly traded assets, that cost will be smaller (an amount equal to the bid-ask spread). For a private company, this cost will be larger, because there will most likely be relatively few potential buyers.

There are several approaches to measuring liquidity risk premiums, however it should be noted that liquidity discounts are likely to vary across both investors and potential private equity investments[17]. For instance, certain private companies may hold larger balances of cash and marketable assets, in which case they would be easier to sell. Also, certain investors will have different preferences for liquidity in their portfolios, which will impact the size of the discount they apply.

An annual liquidity risk premium of 3.2% was applied to private equity investments within the MARF, based on the average results of the PwC survey referenced in the ERP section[21]. The reasonableness of the 3.2% value provided by the survey was assessed using an option-based model[22] that attempts to estimate an upper bound on the liquidity discount. The premise behind the option-based model is to assume that an investor exists with perfect market timing abilities and this investor holds an asset which cannot be sold for a period of time. Without the trading restriction and with perfect foresight, the investor would sell the asset at the maximum price the asset reaches over the holding period. However, given the trading restriction, the investor is forced to hold the asset until the end of the holding period. Therefore, the difference between the maximum price during the holding period and the price the investor is forced to sell at is the upper bound on the value of marketability. The author also makes clear that the higher the volatility of the asset, the higher will be the discount that should be applied to it.

Figure 7.7
Calculating PE risk adjusted returns (example for Ecomond Oy)

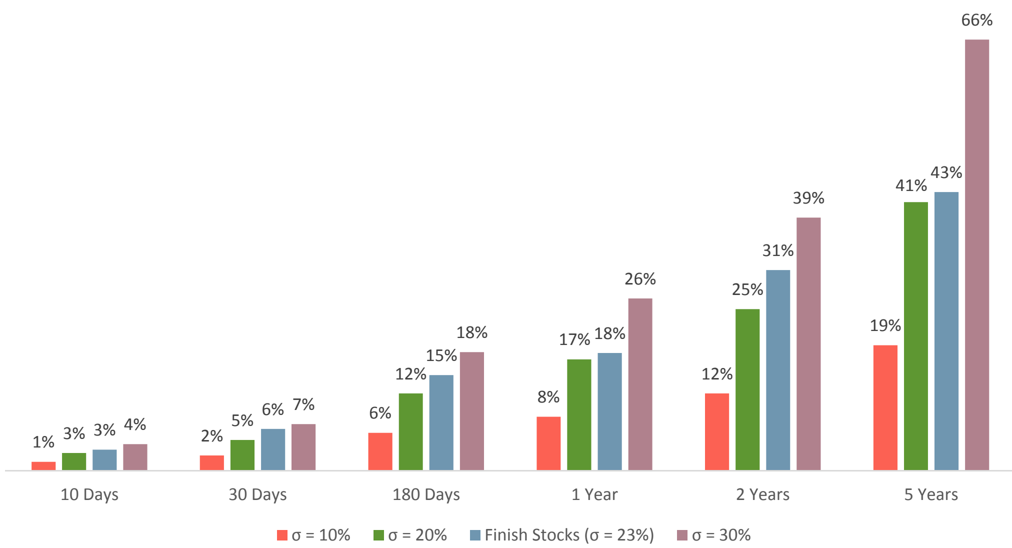


We performed an option-based model on ten years of historical data for every company making up the Finnish HEX index. If the holding period for a stock is restricted to five years, meaning an investor has to hold a common stock within the HEX index for five years, an average upper bound discount of 43% is found. Based on the PwC survey results, the upper range of respondent answers for estimates of liquidity risk premium was 50% in Finland. As such, we believe our calculations support the reasonableness of the PwC survey findings. The results for the model applied to the Finnish HEX index as compared to the Longstaff model can be found in Figure 7.8.

Country Risk Premium. Investors who invest globally are exposed to additional risks over and above investors who concentrate their portfolios domestically[19]. Country risk exposure varies across countries but can be attributed to factors such as where the country is in its economic growth lifecycle, political risk, differing legal systems, or a country's dependence on a particular commodity.

It is necessary to incorporate a country risk premium into our CAPM formula, because we are leveraging information of US-based public comparables for many of the Finnish based private companies allocated to the private equity asset class. One widely used method of measuring country risk is to use the spread on sovereign CDS contracts[19] as a proxy. A CDS contract allows the buyer to insure against a credit event (default or restructuring) of the underlying reference entity, in this case a sovereign bond, in exchange for making regular payments to the is-

Figure 7.8
Calculated liquidity premiums, and comparison of the Finnish HEX index with the Longstaff[22] model

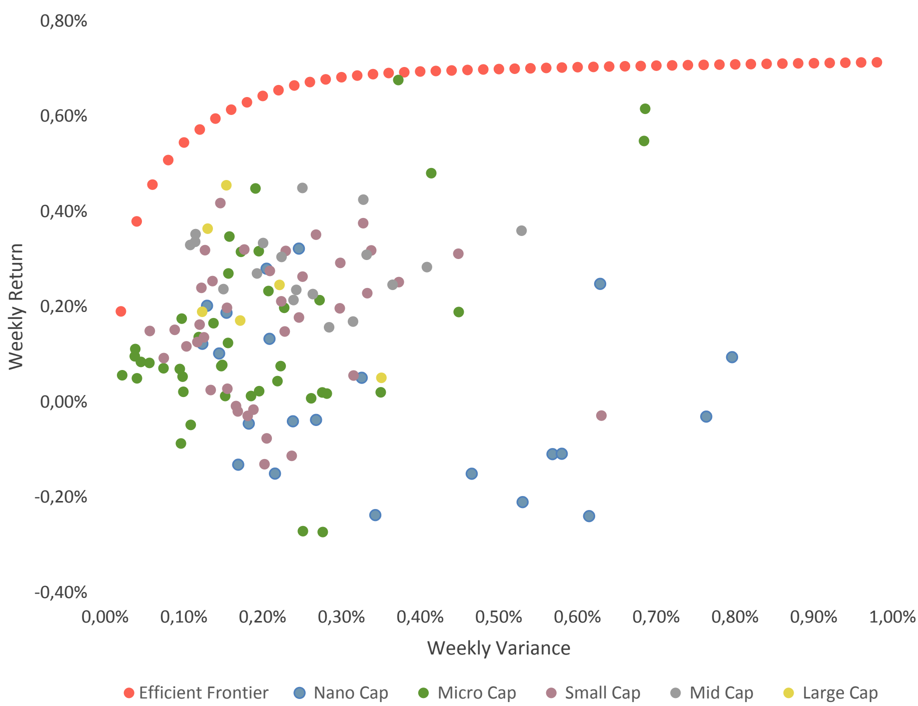


suer. The payments are calculated as a percentage of the notional value and is referred to as the contract spread. In using CDS spreads as a proxy for country risk, we are assuming away counterparty risk and liquidity risks that are inherently priced into a spread; meaning we assume that country risk is the only risk being priced. Our expanded CAPM formula adds a country risk premium of 0.26%, which was the spread on Finnish sovereign bond CDS contracts in April 2016.

Checking the Results. With the volatility and return numbers calculated from the estimated beta for the company, we compared them to the overall stock market in Finland. Figure 7.9 shows what the Finnish stock market looked like in the past 10 years. In this figure it is also possible to see what the return would be for the most efficient portfolios at each given level of risk. If the calculated risk-return profile for the company was substantially different from historical overall market returns, we would revisit our calculations and check if better comparable companies exist. Also, if the variance for the company was in the lower range of the market we would also revise the comparable companies to reflect the higher risk associated with smaller, private companies.

The accuracy of the estimation output is highly subject to the quality of the comparables

Figure 7.9
Historical risk-return profile of the Finnish stock market



Recommendations. In utilizing a public comparables approach, the accuracy of the estimation output is highly subject to the quality of the comparables used as inputs into the model. The most important step in the PE risk assessment model is finding public companies with business models that are truly representative of the private company. Often times, larger conglomerates will have business lines within the company that are comparable, however those business lines may only represent a small portion of the conglomerate's total revenue. It is therefore not meaningful to use a company such as a General Electric as a comparable for a smaller company. For these companies to serve as a public proxy for SMEs, the separate lines of business need to be considered when using financial metrics. Hence, thorough qualitative analysis is required to find public comparables where the primary revenue generating business is similar to the private company being analyzed.

SME private debt risk and return analysis for MARF companies

Thirty-five percent of the potential MARF will be invested in small or medium enterprise (SME) leveraged debt. Important for the risk assessment is to financially define an SME in the EU: a corporation with less than 250 employees and an annual turnover with less than 50 million Euro or a balance sheet total of less than or equal to 43 million Euro.

Current Funding Gap due to Banking Regulations. There is a market opening for SME debt investors due to the increase regulation of banks since the 2008 financial crisis. The most recent and prominent international regulations, known as Basel III, encourage banks to deleverage their assets[23]. The Basel III leverage ratio, which was implemented fully in 2015, required banks to deleverage their capital in order to protect against a future "run" on the banks if another economic downfall similar to 2008 were to occur[24]. Seven percent of Finnish SMEs report having trouble receiving financing; additionally, SMEs, which do receive financing, have interest rates that are 180 points higher what large enterprises pay[25]. Therefore, there is a gap between banks and SMEs' ability to receive capital in order to continue operations.

New Investing Market. The aforementioned gap opens a new market for future SME investors. European SMEs will need 2.4 to 2.8 trillion Euros from 2014 to 2018[26]. With the large amount of capital SMEs need and the decreased lending potential of banks due to deleveraging, SMEs must find financing from outside debt investors. Compared to corporate debt investors, SME investors perceive SME loans to be riskier due to SMEs' smaller size and often large emphasis on human capital[27]. In order to determine the premium that an investor must demand, the investor needs to know the risk of the asset class. However, the main challenge for SME debt investors is to determine an SME's risk level.

Risk and Return of Private Debt. Illiquidity, informational opacity and size are risks that affect SME private debt. The size of SMEs affects the financing they receive. Economies of scale exist for larger corporations that issue public securities, but these economies are not realized with firms in the SME environment[28]. The size and capital structure of SMEs affects their ability to raise debt on the private markets. This is in part due to the limited auditing record of their financial statements, the marginal capacity to pledge business equity as collateral, and the absence of public records on repayment history and record of profitability. The availability f data varies from country to country.

The illiquid nature of private debt causes the asset class to contain a premium. Private debt cannot be easily sold or converted to cash, so investors demand a premium on the return[29]. Even with the illiquidity, size and private nature of this asset class, private debt has recently offered generous returns. A private debt fund outperformed the Euro Stoxx 50 from 2013 to 2014, and has an expected return of 7% for 2015 to 2017.

Risk rating methodologies of SMEs are tied into risk of loan default

Often the riskiness of a debt instrument lies in the issuer's chance of default. As debt instruments have changed, scholars have changed their methodologies to determine the probability of default for this asset class. Two broad methodologies exist to determine the default probability of a debt issuer: quantitative and qualitative. Scholars argue that models that incorporate qualitative and quantitative data outperform models that rely solely on quantitative metrics[30].

Scholars argue that models that incorporate qualitative and quantitative data outperform models that rely solely on quantitative metrics

The literature describing probability of default focuses on the issuing firm's financial ratios. Over the years, various ratios and methods of analyzing such ratios have evolved to accommodate debt instruments, whether they are public or private firms. Beaver[31] analyzed six financial ratios in a univariate statistical model to determine how well financial ratios could predict if a firm failed or did not fail. He found that cash-flow to total-debt could correctly identify failed and non-failed firms much better than one could through random prediction.

Altman[32] built on Beaver's financial ratio analysis and has improved models to fit new forms of debt instruments, including private SME debt. The Z-Score analysis used financial and economic ratios to determine the probability of default for manufacturing corporations. A multi-discriminant analysis was conducted to find five ratios that could significantly predict probability of default: Working Capital/Total Assets, Retained Earnings-to-Total Assets, EBIT-to-Total Assets, Market Value Equity-to-Book Value of Debt, and Sales-to-Total Assets. A firm would fall into three categories based on a final discriminant function with coefficients for the previously mentioned ratios; the categories were non-bankrupt, bankrupt, and zone of ignorance[32]. A new Zeta analysis incorporated seven financial ratio variables[33]. The new Zeta model could better predict a firm's probability of default compared to the previous 1968 model.

Due to the differences between SMEs and larger corporations, scholars have developed new models to determine probability of default for SMEs. Altman and Sabato[34] developed a quantitative analysis to determine probability of default for SMEs in the U.S. market. The model is based on five accounting areas and found significant ratios for each: Profitability (EBITDA-to-Total Assets), Leverage (Short-Term Debt-to-Equity Book Value), Liquidity (Cash-to-Total Assets), and Activity (EBITDA-to-Interest Expenses). Based on a logistic regression, the probability of default for SMEs was assessed with an accuracy level of 87%, which outperformed Altman's Z-score[32] model applied to the same data set[34].

Non-accounting variables can be better predictors of corporate failure and financial distress for SMEs compared to financial ratios

In addition to quantitative analysis, research has proposed the incorporation of qualitative data to determine probability of default. Non-accounting variables can be better predictors of corporate failure and financial distress for SMEs compared to financial ratios[35]. Event or qualitative data, such as county court judgments, whether a firm is audited, a firm's age, if a firm has subsidiaries, and whether a firm issues a cash flow statement can improve the probability of default prediction[35]. The addition of qualitative to Altman et. al.[34] analysis improved the model's classification by 13%[36].

Modeling the debt risk rating for small and medium enterprises

In Finland, companies are required to report their financial statements to a central organization, Asiakastieto, regardless of whether they are publicly traded or privately held (Figure 7.10). The financial metrics that the companies must report are very granular, with over 130 metrics in total. In addition, Asiakastieto tracks credit information related to these companies such as late bill payments or bankruptcy filings. Through

ETLA, we were able to access this dataset for all Finnish companies from the year 2002 until 2015. This dataset was then pared down to just SMEs based on the revenue criteria set by the European Union.

Prediction of loan default. For our analysis, we are interested in predicting whether a company will default in the coming year based on their reported financial statements from the previous year. As such, the credit information for year 2002 was not used because we would have needed the financial statements from 2001, which were not part of the dataset. Similarly, we did not use the financial statements from 2015 because we do not yet know whether these companies will default in 2016.

Figure 7.10
Summary of Asiakastieto Credit History Dataset from 2003 through 2014

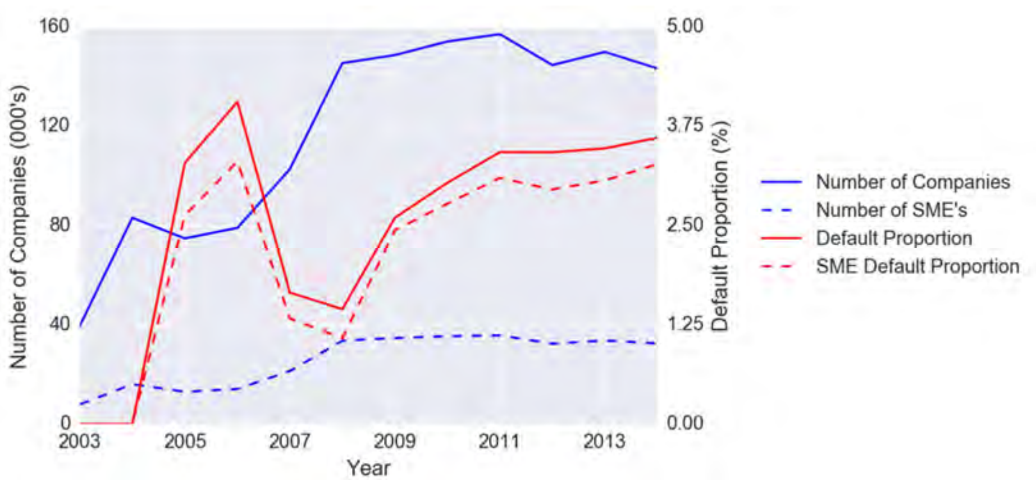
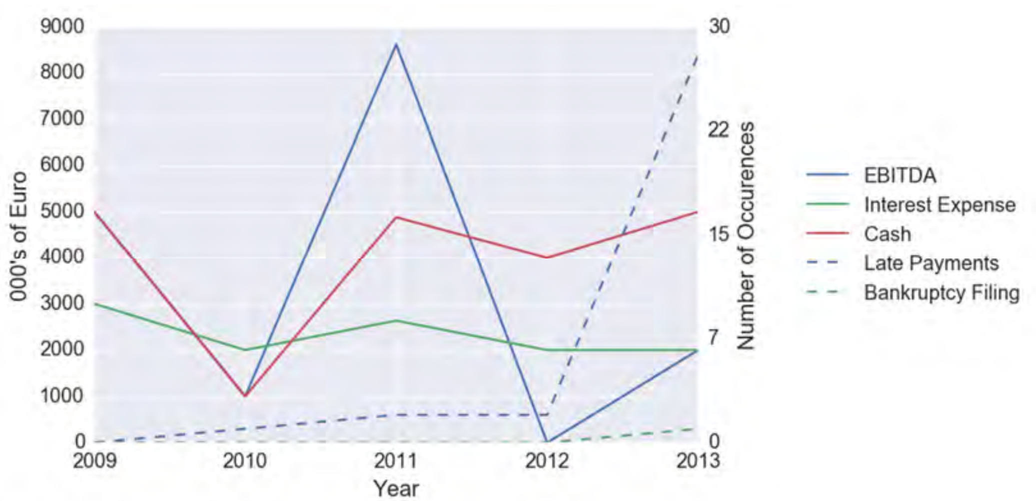


Figure 7.11
Performance of Wuha Oy leading up to their bankruptcy filing



By comparing the mean historical default proportion (about 2.5%) between SMEs and the entire population of Finnish companies we found that there was no significant statistical difference. To illustrate the objective of our models, the performance of Wuha Oy from 2009 through 2013 is shown in Figure 7.11. Starting in 2010, Wuha has at least one late payment each year. Then in 2012, their EBITDA is less than their interest expense and their bankruptcy filing is reported in the following year. Ideally, the model we develop would predict a gradually increasing probability of default leading up to 2012.

Based on our literature review, we chose to build several different types of models and compare their performance. Regardless of the specific type of model, they all aim to solve the same problem: predict default based on a set of features that describe the firm. This is shown schematically in Figure 7.12. Two of the models used, linear discriminants analysis and logistic classification, have been widely used in the literature and are not discussed in detail here.

The decision tree, AdaBoost, and Random Forest™ models however are less known. Each of these aim to capture the underlying intuition that humans use to make decisions. Decision tree models use threshold values for the features of an observation to determine the classification that the observation belongs to, as shown in the inset of Figure 7.13. The threshold values used to make decisions are optimized with the goal of maximizing model accuracy. In our case, the features are financial metrics of a firm and the classification is whether the firm will default or not. Decision tree models use a single tree to make all predictions. In contrast, AdaBoost and Random Forest™ use an ensemble of trees, as shown in Figure 7.13, to make their decisions[37]. This is anal-

Figure 7.12
Schematic representation of probability of default models

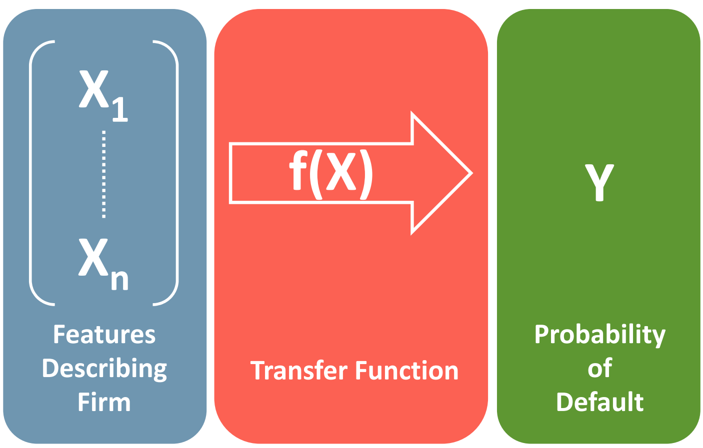
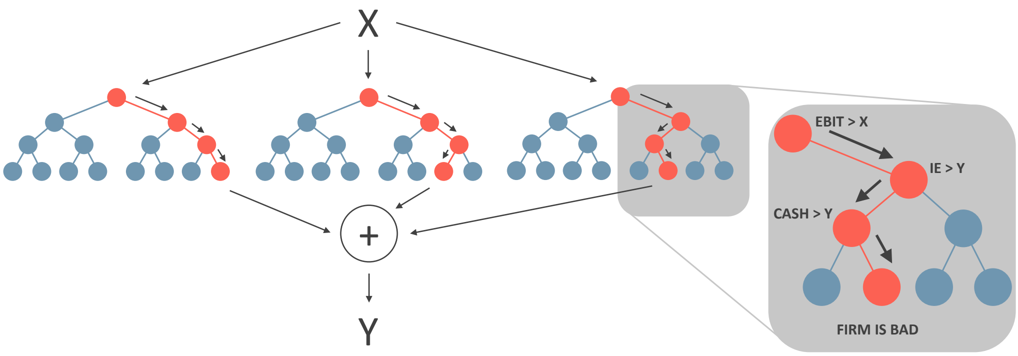


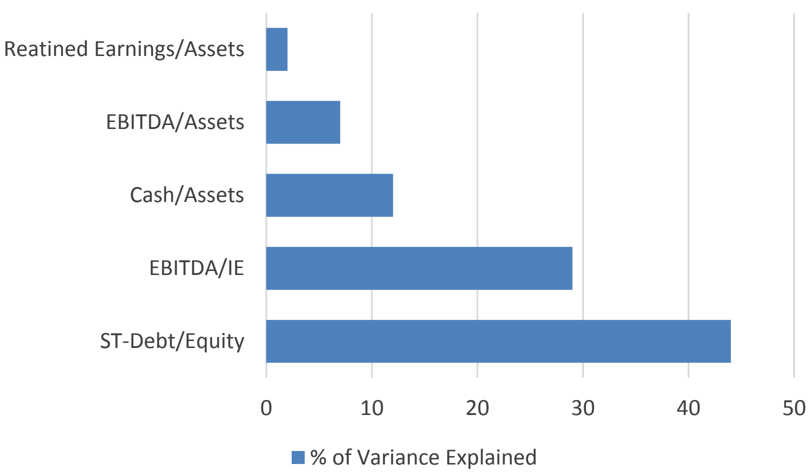
Figure 7.13
Underlying structure of AdaBoost and Random Forest™ Models



ogous to using the vote from a team of analysts to determine a firm's credit worthiness. It should be noted that the AdaBoost algorithm can make use of any type of classifier and is not limited to decision trees, but our work only uses AdaBoost in combination with trees[38, 39].

Despite the richness of the Asiakastieto dataset, we chose to limit the number of financial metrics used describing each firm to those used by Altman to assess US SMEs[34]. This decision was further supported by a principal components analysis which showed that these five metrics explained 93.7% of the variability in the dataset, as shown in Figure 7.14. Interestingly, the two ratios short-term debt-to-equity and EBITDA-to-interest expense (IE) explained over 70% of variability in the data.

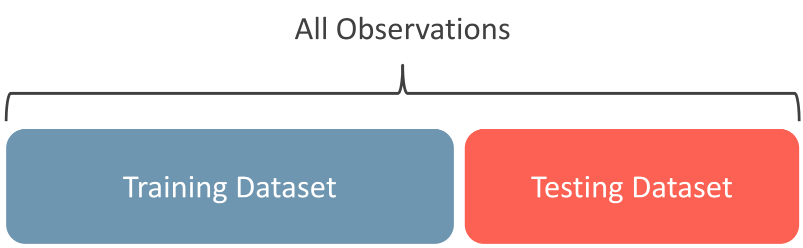
Figure 7.14
Principal Components Analysis on Altman's five financial ratios for SME's



Next, these ratios were assembled with a label indicating the default status of the firm in the following year. This resulted in 311,048 observations for use in training and validating our models. Further inspection of the data revealed that some companies were subsidiaries of much larger conglomerates, who were loading the smaller firms up with debt. In these cases, the firms appeared as though they would default given their small ratio of EBITDA to interest expense but the support of the parent company prevented this from happening. Since there was no variable in the dataset indicating whether each firm was a subsidiary or not, we chose to winsorize the data with a limit of the 99th percentile. Since it was not feasible to review the financial statements of all the companies in the dataset, this limit was chosen empirically based on improvement of model accuracy while modifying as few data points as possible.

In order to avoid over-fitting, cross validation was used to randomly split the dataset into training and validation datasets as shown in Figure 7.15. Then, models were built using only the training dataset and evaluated using the test dataset. This approach typically yields models that perform better on future data points[40].

Figure 7.15
Splitting of dataset for cross-validation



Classic models such as discriminants analysis and linear regression have well-understood coefficients and methods for testing their significance such as the F-test[41]. But, new models, such as AdaBoost and Random Forest™, do not strictly adhere to the structure of such models and have thus driven the development of new metrics.

One of the most common metrics in the case of binary classification is the Receiver Operating Characteristic (ROC) plot[42]. The ROC plot shows the change in true positive rate versus false positive rate as a result of varying the decision threshold for a binary classifier. The decision threshold being the value at which the classifier decides which class an observation belongs to. The results from training a variety of models are presented in Figure 7.16. The three machine learning algorithms out-performed the model for US SMEs[34], indicating that the default risk of Finnish SMEs may differ from that of US based SMEs. For low threshold values, the classic linear discriminant analysis and logistic models significantly out-perform Altman's model but their ability to distinguish good and bad firms drops below Altman's model around a false positive rate of 0.29.

Understanding how ROC curves translate into practical usage is difficult, so the results from Figure 7.16 were translated into expected return on a portfolio of debt. To demonstrate this, a hypothetical situation was developed in which a lending agency uses a given model to predict probability of default for a universe of companies. Then all of the companies are sorted from lowest probability of default to the highest and begin investing in the best firms first. It is assumed that the portfolio is so large that no single company will take on more than 0.1% of the capital available for lending. Thus, if only one loan is issued, 99.9% of the portfolio remains as cash and has an expected return of 0%. Firms that do not default provide a return of 5% but if they default, the loss is 100% of the loan amount.

The results from this analysis are shown in Figure 7.17., and expose two interesting insights. First, the maximum expected return provided by each classifier occurs at different proportions of investment in the universe of companies. In the case of the Random Forest™ model, this occurs at around 58% but for the Altman[34] model it is between 60–70%. Unfortunately, it is impossible to know this profit maximizing thresh-

Figure 7.16
ROC curves showing the out of sample performance for each model

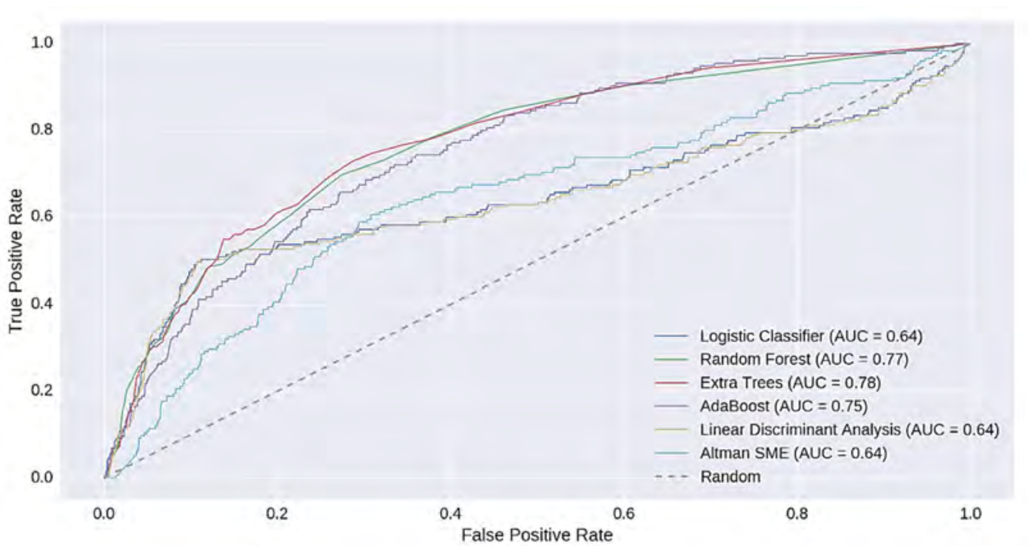
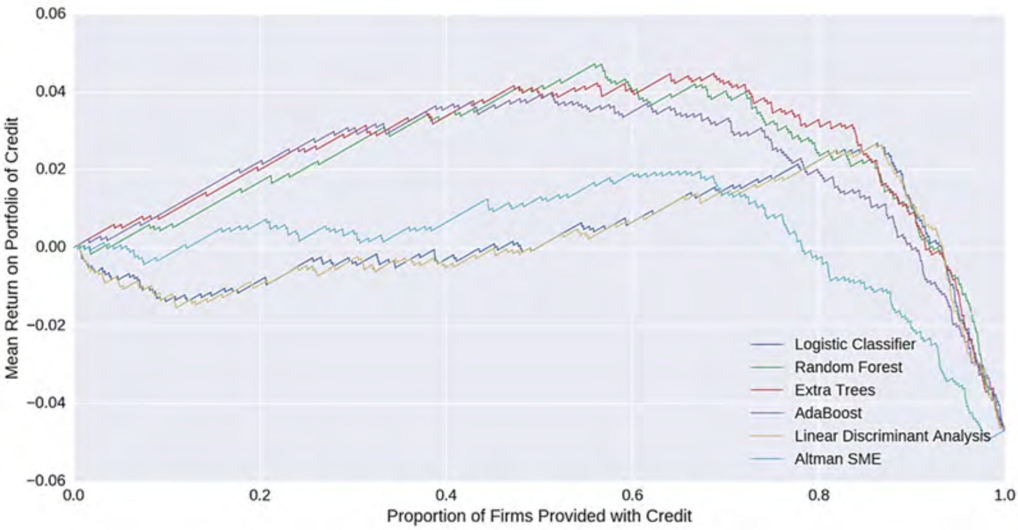


Figure 7.17
Credit portfolio performance depending on model used to determine credit worthiness of SMEs



old a priori but its impact can clearly be seen in Figure 7.17. For instance, the logistic model provides a negative return up to roughly 50% but eventually surpasses the Altman model[34] when nearly 90% of the investable universe is provided with credit. The second insight is that the machine learning algorithms provide almost no window of negative returns until a very large proportion of firms are given loans. If this characteristic holds for tests on additional out of sample data, it is a distinct advantage over the other models

Based on these results, we chose to use the Random Forest™ classifier for our probability of default predictions.

Finding Comparable Companies. Using the probability-of-default model developed in the previous section, we generated time histories of the probability of default for each of our target firms. Based on this data we used research from Standard and Poor's to estimate the ratings of their bonds. This rating and the target company's industry code was then used to select a universe of comparable companies. From within this universe, a best fit comparable company was selected based on correlation of the time histories of probability of default and EBITDA. The debt from this best fit company was then used as a proxy for our target company.

Historical Volatility. The debt issues of each target company's best fit comparable were used to estimate historical volatility. This was done by using Bloomberg databases to retrieve the structure of the issue and its historical clean price. The price at which a bond is actually purchased is known as the dirty price. This price includes the accrued interest of the forthcoming coupon payment. As a result, the dirty price drops significantly on the day following a coupon payment. In contrast, the clean price is the dirty price minus the accrued interest. Thus, in order to calculate historical returns we defined the weekly return as:

$$return_i = \frac{p_i + r_{cpn} * Par}{p_{i-1}}$$

where: p_i = daily mid clean price at week I; r_{cpn} = bond coupon rate stated on a weekly basis; Par = the face value or principal of the bond

Additionally, upon payment of a coupon, these proceeds are assumed to have been reinvested into the same bond according to the dirty price from the exchange on the day after the coupon was paid. Ideally, clean prices would be retrieved for the previous 5 years, but in some cases only 3 years of data were available for the best fit comparable companies. In these cases, only the data available was used. The historical volatility was then calculated as the standard deviation of the weekly returns.

Future Returns. The mean of the past month's Yield to Worst on our best fit comparable bonds was used to estimate the future returns on the target company's debt. This was chosen because it most accurately reflects the current interest rate environment and any risks specific to the industry[43]. The exact time window used to calculate future yields for our target companies was 03/21/2016 to 04/15/2016.

Liquidity Risk Premium. Due to the illiquid nature of SME debt, a risk premium needed to be added on top of the expected yield developed above. This was calculated in a similar manner as Private Equity using an options-based approach to value liquidity over varying time horizons and volatility[44]. Based on the selected universe of comparable companies, the mean liquidity risk was estimated to be 1.6%.

Country Specific Risk Premium. A second risk premium was added to the expected yield which accounted for country-specific risk. This was calculated as:

$$r_{country} = r_{f,comparable} - r_{f,target}$$

where: $r_{country}$ = country specific risk premium; $r_{f,comparable}$ = rate on treasury bond of comparable company's domicile of risk; $r_{f,target}$ = rate on treasury bond of target company's domicile of risk

In addition, both risk free rates, the rates on the treasury bonds, were matched for maturity to that of the comparable company's bond issue. This premium ranged from 0.63% to 1.57% depending on the maturity of the comparable issue.

Risk and return analysis for MARF climate bonds

As explained in Chapter 6, a climate bond is a thematic debt security focused around climate mitigation projects. As is the case for other bonds, it is paid off at maturity through repayment of the bond's face value, and it can also be structured so that the issuer is obliged to make periodic coupon payments, as interest, until maturity[45]. The first climate bond was issued in 2007 by the European Investment Bank (EIB). The EIB sought to create an investment vehicle which provided climate mitigation and adaptation initiatives with access to mainstream capital. These initiatives previously relied on non-traditional investment vehicles, which carried terms not suitable for large portfolio investors. The EIB's creation of this asset class enabled institutional investors to join the climate solution investment marketplace[46].

EIB sought to create an investment vehicle which provided climate mitigation and adaptation initiatives with access to mainstream capital

The capital raised through climate bonds is earmarked for projects that are categorized into the following groupings[47]:

- **Energy** – Renewables, distribution/management, storage, products that support Smart Grid, data centers using renewable energy
- **Energy efficiency** – Green commercial buildings, green residential mortgages, energy efficient technology and products, industrial retrofits
- **Transport** – Public (rail, bus rapid transit), electric vehicle infrastructure, cycling rental schemes and infrastructure, low emission vehicles
- **Water** – Storm water adaptation, investments dealing with rainfall volatility, water treatment and recycling, waterway adaptation
- **Waste management** – Waste water treatment and methane capture, waste to energy
- **Land-use** – Sustainable forestry and supply chain, sustainable agriculture and supply chain
- **Adaptation infrastructure** – Adapting infrastructure to increased head stress, ports redevelopment to address sea level rise, storm surge protection, broadband

Despite the issuance of the first climate bond in 2007, the market saw little growth through the end of 2014, with only nine bonds trading globally in the secondary market. Since then, the secondary market has expanded to approximately 180 bonds. Finland recently joined the chorus of climate bonds with an an issuance with broad debt finance applications.

Slow initial growth in the market is partially attributed to ambiguity in the definition of a climate bond[47]. Across and within investment ecosystems, issuers set unique climate bonds standards, requiring investors to conduct due diligence to determine if specific bonds met portfolio standards. To overcome this inconsistency, The Climate Bonds Initiative, an investor-focused not-for-profit organization, was founded and has created a Climate Bond Taxonomy.

The Climate Bond Taxonomy defines climate bond standards and outlines an official certification scheme which can be employed to help standardize the asset class[48]. Standards used in this taxonomy are defined by a board of sector-specific experts. Scientific thresholds defined are grounded on the most commonly accepted analysis of emission mitigation pathways. These standards are then used by third-party organizations who are able to certify which bonds are indeed climate bonds. To date, the climate bond universe, including labelled climate bonds and unlabeled climate-aligned bonds is approximately $600 bn., a nearly 10-fold increase over 2015.

Climate bond specific risks are the same as conventional bond risks. Depending on the climate bonds selected for the MARF, the following risks may apply:

- **Call risk** – a bond is called back by the issuer before maturity, typically driven by lower interest rates in the market
- **Reinvestment risk** – after a bond has been called back, an investor can only reinvest in lower return bonds
- **Credit risk** – the inability of the issuer to make interest payments
- **Interest rate risk** – an investor cannot immediately recover funds for alternative investments if market rates go up
- **Liquidity risk** – the inability to quickly sell a bond via secondary market
- **Currency risk (international bond)** – currency rate changes that impact realized return across international markets

Credit risk for bonds is assessed by credit rating agencies, if hired by the issuer. The most commonly used credit rating agencies include Standard & Poor's, Moody's, and Fitch. These agencies use a combination of qualitative and quantitative metrics to conduct their analysis to provide a credit rating. Metrics employed typically include:

- **Predictability of cash flow** – the ability of a company to earn cash
- **Adverse scenarios** – an estimate of each issuer's response to a selection of possible future scenarios, both at the broader macroeconomic level and at a level more specific to the issuer

- **Default severity** – an estimate of the probability of default on debt, and the expected loss in case of default. The expected loss may be less than 100% of the debt or may result in delayed coupon payments
- **Sector specific** – an assessment of demographic trends or future regulatory changes within an industry
- **Insider information** – information not disclosed to the public, used to determine the financial outlook for a particular company

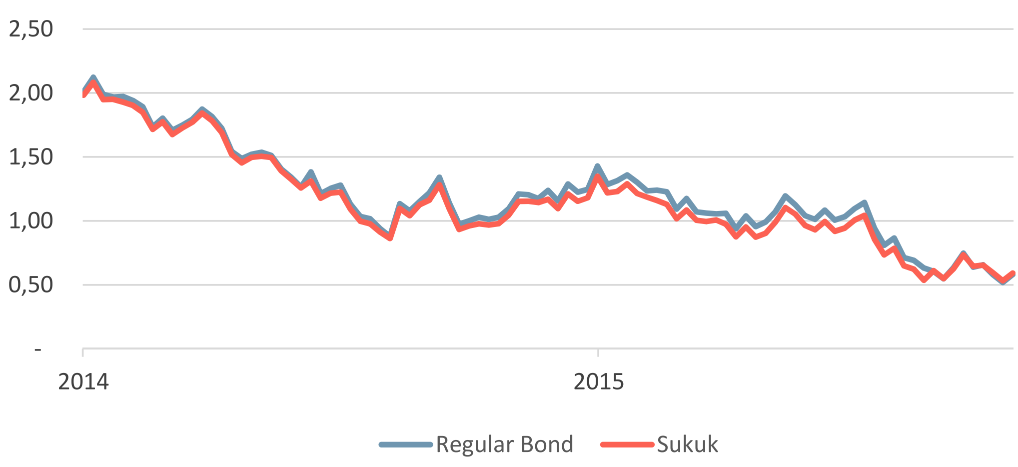
Credit rating agencies re-evaluate ratings on an annual or bi-annual basis; however, if substantial changes occur in a company's policies, the general economy, or any other demographic factors, an agency may issue a revised credit rating.

Measuring climate bond returns and risk is difficult due to the short history of this debt security

There are two primary obstacles in calculating the return and variance of climate bonds: Limited quantity of qualified climate bonds – due to the limited existence of the asset class, our analysis was restricted to 16 climate bonds currently in the marketplace; and Limited history of return performance – due to the short history of the asset class, the available amount of historical performance data was minimal

Additionally, many investment managers indicated that there was a broad assumption in the market that investors would be willing to pay a premium for certified climate bonds, so we looked to the market for validation. The basis for the assumption is that climate bonds are more costly due to administrative expenses associated with green compliance

Figure 7.18
Comparison of Sukuk bond and UK gild



requirements to demonstrate that the bond's investments have the intended environmental impacts. The rationale for testing this hypothesis is that if climate bonds are sold and traded at a premium versus conventional bonds with the same structure and risk profile, MARF portfolio returns would be negatively impacted.

As a first proxy for climate bonds, we first investigated Sukuk bonds, which are debt securities designed to generate returns without infringing on Islamic law, which prohibits payment of interest[49]. The first Sukuk bond was issued in 2000 by Malaysia. Since then, Sukuk bonds have been issued by multiple states and corporations. Our analysis focused on two sovereign bonds in the UK market with the same maturity and seniority. Since June 2014, the Sukuk bond has traded at little to no premium versus a conventional UK gild as shown in Figure 7.18.

As a second proxy for climate bonds, we examined one of the most liquid climate bonds in the global marketplace, which was issued by Apple Inc. in February 2016. The universe of climate bonds shows the yield of bonds as a function of their ratings (AAA to BBB) and maturity (Figure 7.19, top). If we extract Apple's climate bond (rated AA+), and map it on a AA yield curve, it does not appear to yield a premium (Figure 7.19, bottom).

In both instances, we could not prove that climate bonds would trade at a premium, thus our analysis was not impacted by this sentiment.

Value at risk estimates for climate bonds were based on the entire universe of this type of security

To calculate the potential return and variance of a portfolio of assets in this class, we first screened the Bloomberg database for all corporate climate bonds in the global market that had more than 21 weeks of trading history. Additionally, we sought to achieve an average maturity timeline of five to seven years, a time horizon that would fit with the EU Long Term Investment Fund (LTIF), and adheres to general holding mandates of longer-term investors such as pension funds (Figure 7.20).

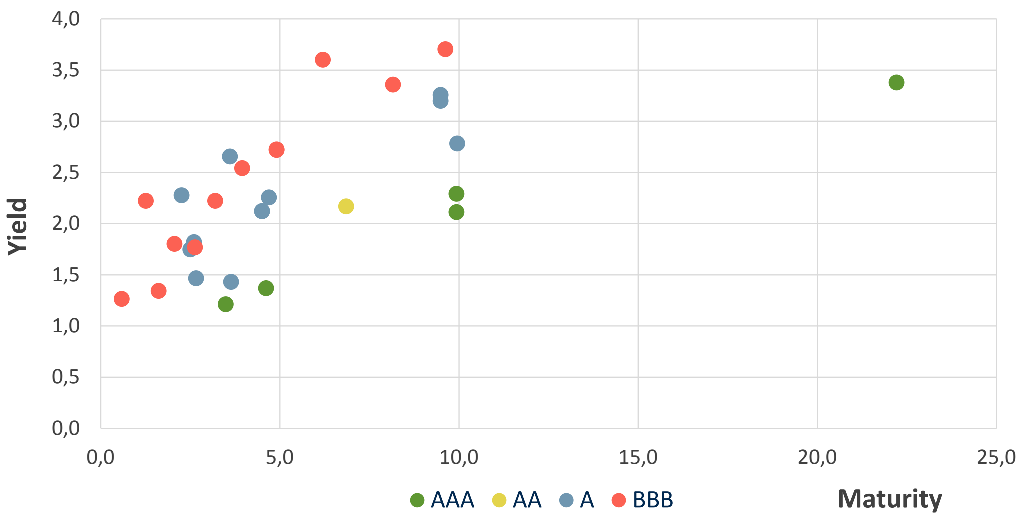
Estimate of returns. An equally-weighted yield to worst (YTW) of 16 bonds was calculated that met the trading and maturity criteria. We restricted our analysis to performance in the same time range used for SME Debt, which reflected the market's most current performance. We employed YTW because it is the most conservative estimate of potential return that an investor can earn[50]. Yield to worst is the lower of yield to maturity (YTM) or yield to call (YTC).

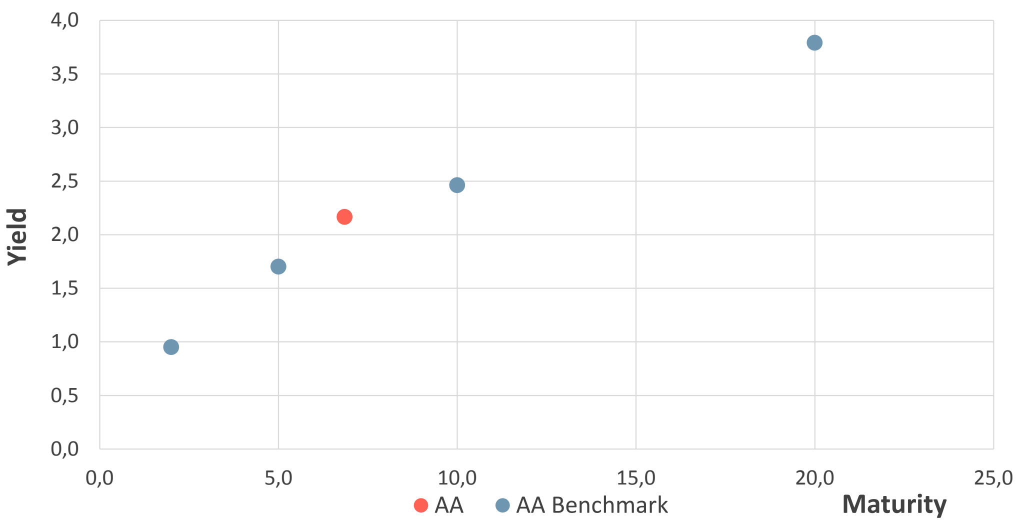
Yield to maturity is the interest rate earned by an investor if they hold a bond until maturity. Mathematically, it represents the discount rate based on the sum of all future cash flows and repayment of the principal, equal to the market price of the bond.

Yield to call is calculated the same as YTM; however, call date and call price are used to determine outstanding cash flows and in place of principal repayment, respectively.

Importantly, YTM and YTC are based on three assumptions[50]: (1) A bond is held until maturity or call date; (2) Each coupon is reinvest-

Figure 7.19
Yield-maturity profiles of current climate bonds (top), and location of Apple's climate bond on AA yield curve (bottom)





ed; and (3) Coupons are reinvested at the applicable YTM or YTC. It should also be noted that neither YTM nor YTC consider the impact that taxes, fees, or commissions have on return; this should eventually be considered at a MARF level based on terms agreed upon with investment managers.

Variance of bond portfolio performance. This was based on sourced 'clean bond prices' from Bloomberg, which were converted to 'dirty prices' based on individual bond terms. We then incorporated dirty price data into the total return equation, as discussed in the SME section. This calculation mirrors the approach employed in determining SME debt variance.

Risk and return analysis for public equities

As was discussed in Chapter 6, public equities can be allocated in different investment vehicles, ranging from stocks in open and closed-end funds, and benchmarked exchange traded funds (ETFs) tracked to a large index. ETFs are pooled funds quoted on stock markets and designed to replicate the performance of a specific asset class[51]. ETFs began trading in 1993 when State Street, an American financial-services group, launched an ETF that tracked the S&P 500. The investing public showed a demand for such a fund. For example, Barclays' TIPS fund commenced trading in December 2003 and this asset class has grown to over $22 billion. Pension funds have shown increasing appetite for investing in ETFs using either an active or passive management strategy.

The benefit of ETFs is low costs, high tax efficiency, and liquidity compared to other asset classes. ETFs generally have lower costs than other funds as a result of client service-related expenses being passed on to the brokerage firms that operate the ETF[52]. ETFs provide tax benefits to investors. Investors do not pay capital gains taxes until the investor chooses to sell the fund shares[52]. The deferral of capital gains benefits tax-exempt investors because unrealized gains do not build up inside the ETF[53].

Figure 7.20
Green bond issue, return and variance used in the MARF

Target Company	Average Return	Average Variance
Vornado Realty Lp	0.04%	0.3%
Anstock Ii Ltd	0.04%	0.1%
Morgan Stanley	0.03%	0.0%
Bank Of America Corp	0.02%	0.0%
Digital Realty Trust Lp	0.07%	0.0%
Georgia Power Co	0.05%	0.2%
Credit Agricole Cib	0.03%	0.1%
Bank Of America Corp*	0.03%	0.0%
Apple Inc	0.04%	0.0%
Regency Centers Lp	0.06%	0.0%
Neder Waterschapsbank	0.04%	0.1%
Ing Bank Nv	0.03%	0.0%
Southern Power Co	0.07%	0.0%
Agricultural Bk Of China	0.03%	0.0%
Hyundai Capital Services	0.05%	0.0%
Kfw	0.02%	0.0%
Credit Agricole Cib*	0.05%	0.0%
Credit Agricole Cib*	0.03%	0.0%
Export-import Bk India	0.05%	0.0%
Goldwind New Energy Hk	0.04%	0.3%
Ing Bank Nv	0.04%	0.2%

*Duplicates on the list indicate separate bond issues by the same company

Unlike the SME debt and private equity portfolio, the ETF in the MARF is a representation of global companies, based on the financial network map and the KeyStone Compact® selection process. In the Smart Mobility map, stocks from the following countries are represented: Finland, Switzerland, Germany, Japan, Canada, Sweden, Denmark, and USA (Figure 7.21). The selection criteria for inclusion in the ETF – which are in line with practice in the financial services industry – are:

Minimum 20% free float of shares. The free-float methodology for calculating market capitalization of an index's underlying companies takes the equity price and multiplies it by the number of shares readily available in the market. Instead of using all of the shares outstanding like the full-market capitalization method, the free-float method excludes locked-in shares such as those held by promoters and governments.

Business diversification. The companies needed to be selected in an 80:20 ratio based on KeyStone Compact® investment grade scores. The majority of companies were placed above the 40% ('upside potential') mark, and preferably in the upper two quadrants (strategic or expansional opportunity) of the investment grade diagram. The rationale for this criteria is to mix diversification in the company's lines of business (above 40%) with more 'pure play'-type companies (below 40%).

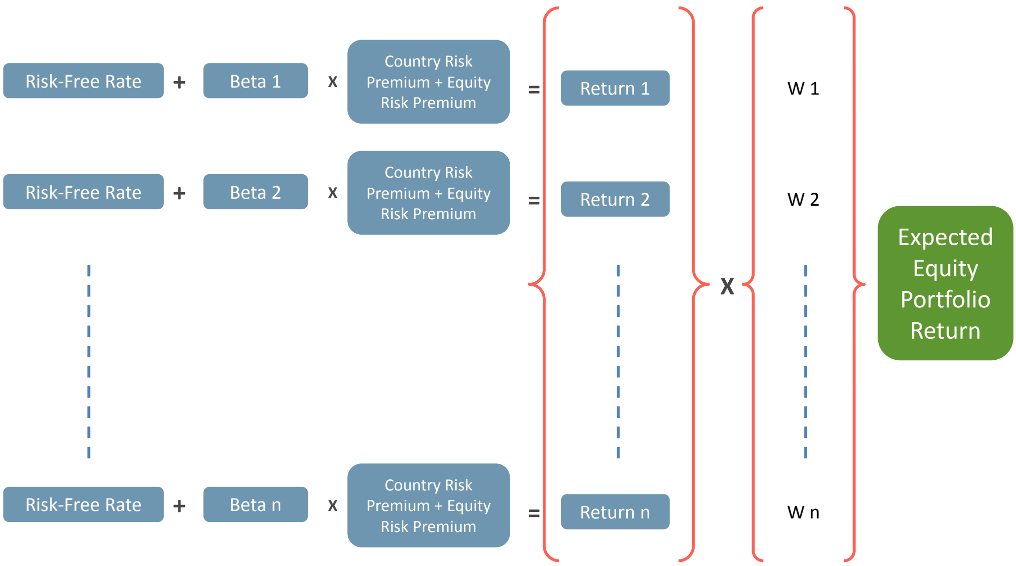
Broad allocation of stocks within ETF. The allocation weights of each company in the portfolio ('w' in Figure 7.22) was restricted to a maximum of 8%, such that overreliance of returns on a limited subset of companies is avoided.

Figure 7.21
Smart Grid and Smart Mobility stocks selected based on financial network maps and stock asset allocation strategies

Smart Grid Stocks	
Telecity	Google
Fortum	Teliasonera
HoneyWell	Prysmian
Murata	ABB
CGI	Siemens
NiceBusiness	Agco
Nokia	Tekla
Elisa	Cassidian
Basware	Microsoft
Oracle	IBM
Tieto	SAP
F-Secure	Kemet

Smart Mobility Stocks	
Ublox	Nokia
Fsecure	Bittium
Wartsila	Cargotec
CGI	Siemens
Murata	Nokian
Elisa	TeliaSonera
DSV	BRP
Kone	ABB
Valmet	Actuant
	YIT

Figure 7.22
Process of calculating expected returns for the equities portfolio using the capital asset pricing model (CAPM)



Measuring Volatility. The ETF's volatility was calculated based on the weekly total return for each stock identified in the financial network map (Chapter 3), and allocated using KeyStone Compact® risk analytics, for the past ten years. The total return accounts for the dividends paid by the stock. Based on weights from the Keystone Compact® selection tool, a hypothetical ETF was created and rebalanced every six months. The allocated weight of the stocks that were not trading during the period of 2006 to 2016 was proportionally redistributed among other stocks.

Measuring Returns. The CAPM was used to find the returns of the hypothetical ETF. For each stock, its beta was selected using the FactSet database. For the risk-free rate of return, the ten-year sovereign bond for each stock's country of risk was used. As in the private equity asset class, the equity risk premium was 5.78% for mature countries[19]. To assign differences for each stock's country of risk, a country risk premium was added as described in detail in the private equity section, based on the Credit Default Swaps. This ranged from 0% for the U.S. to 0.46% for Japan.

Monte Carlo Analysis to Calculate VaR of the MARF

Calculation of the VaR for the entire fund first involves assembling the underlying assets into a portfolio resembling the MARF, calculating the VaR for each asset class, applying a Monte Carlo simulation to model the probability of different outcomes due to the intervention of random variables, and predicting the portfolio VaR for the MARF (Figure 7.23). To allow us to do this we have to choose a specific MARF design (Smart Mobility), allocations between the asset classes (PE, debt, ETF, and climate bonds), and allocations of the underlying assets in each asset class.

Figure 7.23
Approach to Monte Carlo simulations of MARF risk and return

Two types of analyses will be presented: (1) an asset allocation based on maximum benefits to the economy (45% allocated to debt and equity); and (2) an optimized portfolio allocation informed by maximum returns-minimal volatility. The first analysis was used to understand the impact of correlation within and across asset classes on VaR risk in the portfolio, and to position the MARF's risk – returns profile among other investment vehicles available to long-term investors. The second option was chosen to understand what the allocation needs to be to effect maximum returns at reasonable risk.

The risk-return profile of the Finnish Smart Mobility MARF compares to high yield fixed income investments

For our initial analysis we assumed that the weights of each underlying asset (company or bond) within the private equity (10%), SME debt (35%), public equities (15%) and climate bond (40%) classes were evenly distributed based on the total weight of the class within the fund. In reality, the weights of each asset should be optimized to achieve a chosen expected return with minimum historical volatility, also known as an efficient risk-return profile[54]. But, the simplifying assumption of equal weights was made because development of the risk rating framework is independent of this portfolio optimization activity.

Covariance and Correlation. Within the Monte Carlo analysis, the covariance between asset returns is used to calculate expected returns for the portfolio[55]. As is convention, it was calculated as:

$$cov(\boldsymbol{X}, \boldsymbol{Y}) = \frac{1}{n}\sum_{i=1}^{n}(x_i - \mu_x)(y_i - \mu_y)$$

where: **X** = n-dimensional vector of discrete observations; **Y** = n-dimensional vector of discrete observations; n = the number of observations in **X** and **Y**; i = positional locator within **X** and **Y**; x_i = i-th observation within **X**; μ_x = mean value of **X**; y_i = i-th observation within **Y**; μ_y = mean value of **Y**.

Carrying this out across the m assets in the MARF results in an m-by-m matrix of the covariance between the assets. This matrix can be readily used to generate correlated random samples representing expected returns for the portfolio. But, in addition to looking at the historical covariance between assets we wanted to **stress test the model against unfavorable market conditions**. In the case of the 2007–2008 financial crisis, the correlation between assets went to unity (1) causing losses that were substantially higher than expected[56]. In order to explore this situation, a "Worst-case" covariance matrix was calculated as:

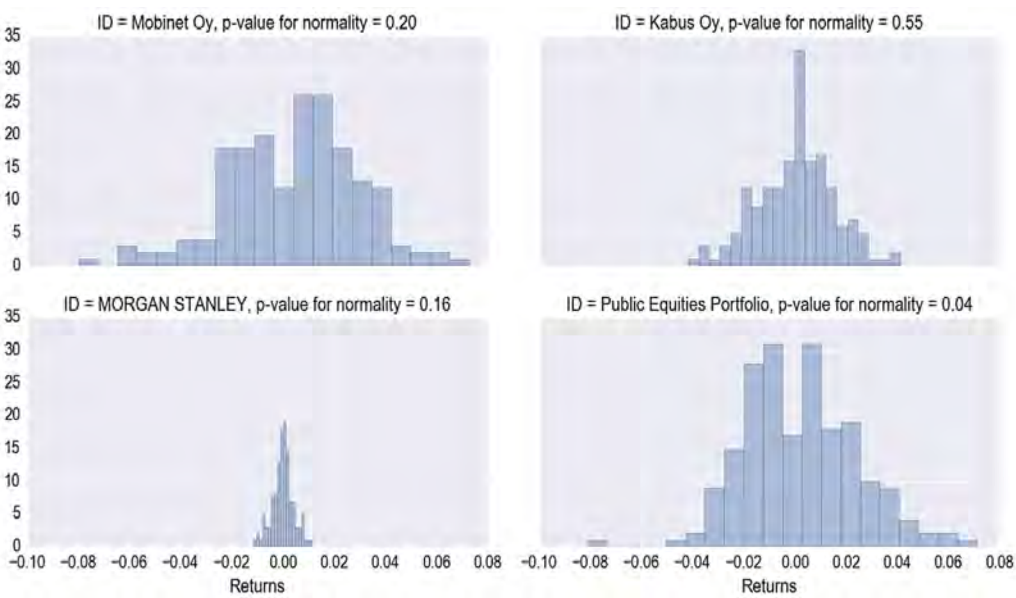
$$cov(\boldsymbol{X},\boldsymbol{Y}) = corr(\boldsymbol{X},\boldsymbol{Y})\sigma_x\sigma_y$$

where: *corr(X,Y)* = correlation between **X** and **Y**, assumed to equal 1 in worst-case

σ_x = standard deviation of **X**
σ_y = standard deviation of **Y**

The returns of an example asset from each class and the p-value from a Shapiro-Wilk normality test on the returns are shown in Figure 7.24.

Figure 7.24
Returns distributions from private equity, SME debt, public equities, and climate bonds (Clockwise from top left)



Recall that the Finnish Smart Mobility companies were allocated to leveraged debt, private equity and ETF asset classes based on non-financial and financial metrics detailed in Chapters 4 and 5. The example shows the data for Mobinet Oy (private equity), Kabus Oy (SME debt), Morgan Stanley (Public Equities portfolio), and Morgan Stanley (bonds). We can see that the returns vary from normal distributions for the public equity portfolio, to highly non-normal distribution for SME Debt. By employing the Monte Carlo technique, we use these underlying distributions to generate a random sample of correlated returns, thus avoiding the common pitfall of using normally distributed returns for an asset with distinctly non-normal returns.

Given the expected return and the covariance and distribution of historical returns for each asset within the MARF, correlated samples for future returns are generated for the desired time horizon[57]. To choose the time horizon, it was important to consider how the risk rating would be used in the context of the MARF. Over a long investment horizon, severe losses will eventually be recovered if the fund is able to avoid large withdrawals of funds and sales of its assets. Thus, we were most concerned with fund losses over a shorter time horizon, since large losses in the short-term can lead to collapse. Indeed, the proposed MARF is structured as a closed-end fund with a one-year lock in period. We found that this is typically how funds use VaR, and this was the basis of the development of the VaR metrics by JPMorgan in the 1990s[2]. The estimates are based on a 1-week VaR but the analysis can easily be extended to longer durations.

Severe losses will eventually be recovered if the fund is able to avoid large withdrawals of funds and sales of its assets

The returns for each underlying asset at the end of the time horizon are then combined to generate the expected return for the portfolio:

$$r_{portfolio} = \boldsymbol{r}_{assets} \cdot \boldsymbol{w}_{assets}^{\boldsymbol{T}}$$

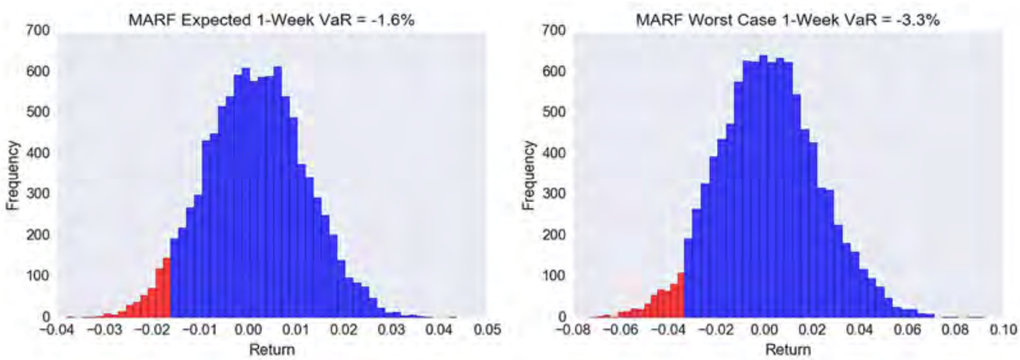
where: $r_{portfolio}$ = weighted return for the portfolio

$\mathbf{r}_{assets}$ = m-dimensional array of asset returns at the end of the time horizon
$\mathbf{w}_{assets}$ = m-dimensional array of weights for each asset in the portfolio

This process is then repeated to generate a distribution of expected portfolio returns at the end of the investment horizon, one-week in our case. **Once a distribution of returns was generated for the fund, the VaR could be calculated**. Since VaR is defined as the loss that will occur at a specific probability, this calculation is quite straightforward once a probability threshold has been selected. We chose to use 5%

based on convention but this can easily be tailored to the specific desires of an investor[3]. Figure 7.25 shows the 5% probability VaR calculated using the methodology described above for both the expected (actual correlation between assets and across asset classes based on available financial data) and worst case (all assets are assumed to be correlated) scenarios, resulting in -1.6% and -3.3% of returns, respectively.

Figure 7.25
Expected and worst-case 5% probability Value at Risk for the Smart Mobility MARF



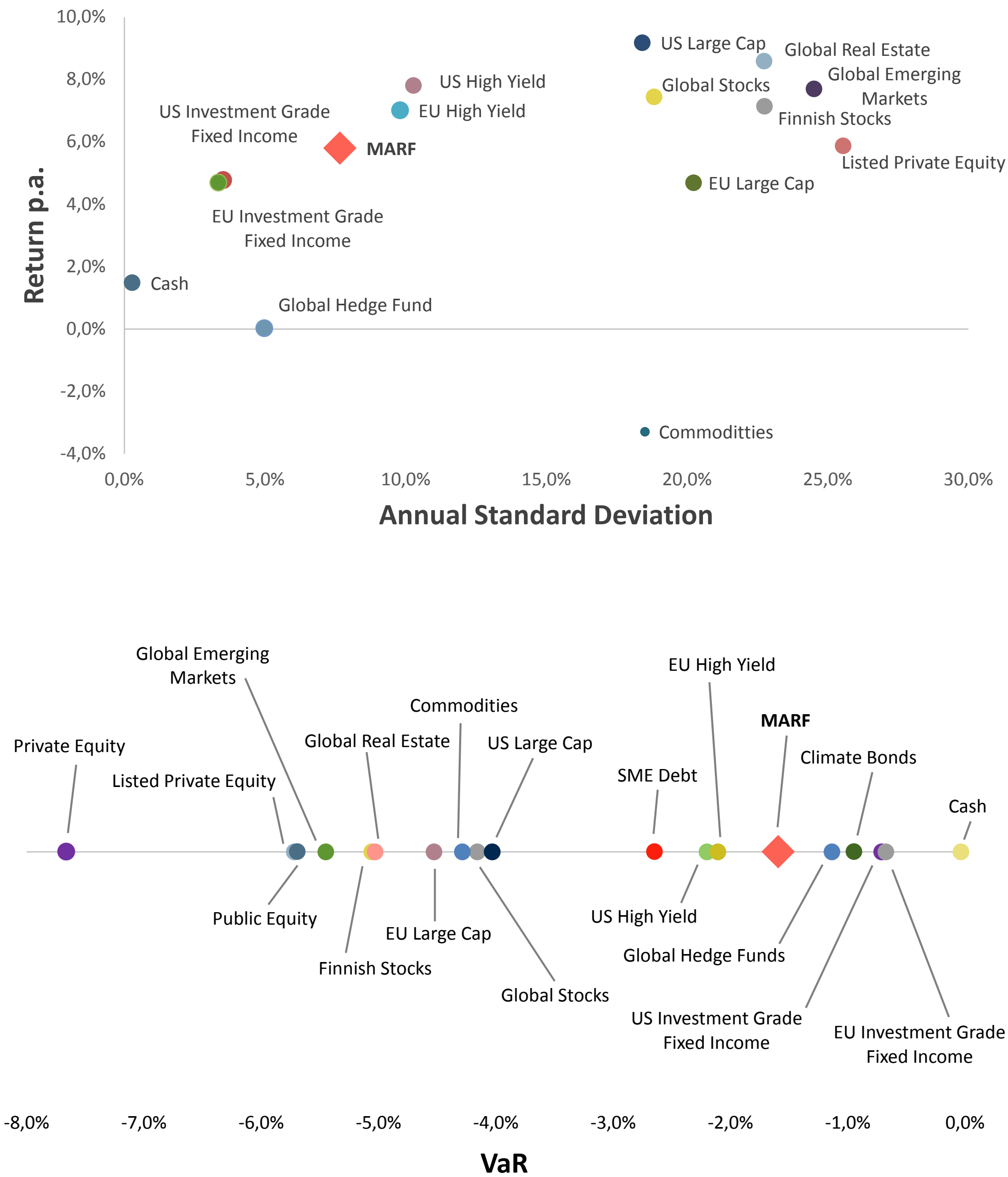
These figures by themselves are not that informative, so we decided to contextualize them. Figure 7.26 puts them in the context of other investment options available to institutional investors, using 2016 Bloomberg data. We see that the risk-return combination of the MARF is positioned between investment grade and high yield fixed income investments.

MARF investment funds demonstrate high diversification benefit across asset classes and perform well in asset correlation stress tests

Given the volume of risky assets within the MARF, the private and public equity assets within the MARF would be expected to have a VaR of -7.7% and -5.8%, respectively, based on single asset class investments shown in Figure 7.26. If that is the case, why did the outcome of the VaR simulation for the entire MARF result in a range of -1.1% (expected) and -3.3% (worst case correlation), well below that of the individual asset classes.

To explore the key risk driver behind this result, we quantified the correlation between the assets that comprise the fund. Figure 7.27 shows that within a given asset class, there is limited diversification benefit, with most assets being positively correlated with one another (tendency towards red-brown colors). This was particularly the case in private equity, with increasing diversification in SME debt and climate bonds. The low diversification within each asset class supports the value of the risk tiering and bundling of companies using the KeyStone Compact® non-financial risk assessment which groups companies with similar risk profiles, and correlates this information to past financial performance. Once would expect that, despite the fact that the companies were sourced from different industry sectors (based on the financial network map), there would be similarities in performance and thus correlation within these clusters and asset classes.

Figure 7.26
Risk-return profile (top) and VaR (bottom) of the Smart Mobility MARF relative to other investments



Does this present a risk for the fund performance? The answer is no on two accounts.

First, the underlying assets are sourced from uncorrelated industries (e.g. telecommunications and home electronics), even if financially there is low diversification between the companies. Second, the value of the MARF construct really manifests itself in the diversification and lack of correlation across asset classes. Looking across asset classes reveals what is driving the low VaR for the fund as a whole. As can be seen in Figure 7.28, the correlations between assets from different classes is near-zero or negative (appearance of blue color) thus providing substantial diversification benefits to the fund as a whole.

Figure 7.27
Correlation between assets within their asset classes

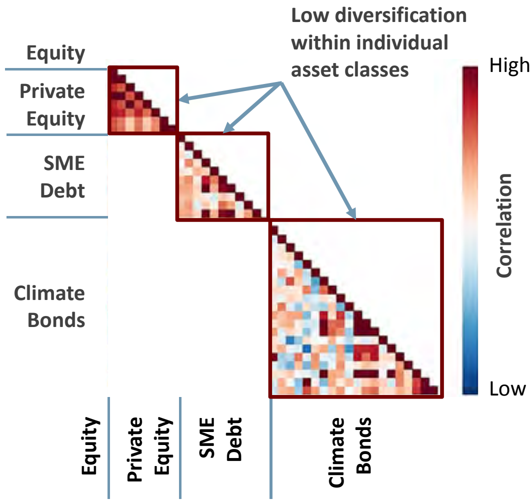
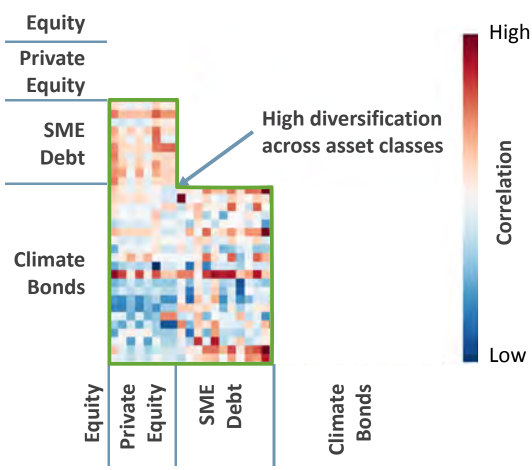


Figure 7.28
Correlation across asset classes

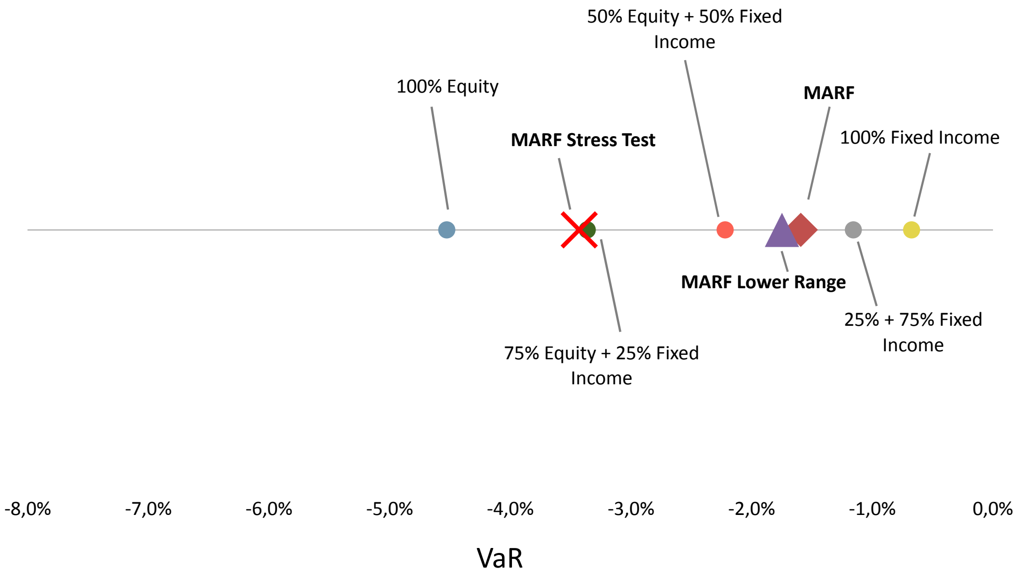


Given this insight, we wanted to test the diversification benefits of the MARF by constructing a set of hypothetical multi-asset funds using equity and fixed income indices. These results are shown in Figure 7.29. As expected, we see that funds with similar diversification as the MARF result in comparable VaR results, rendering the MARF similar to a 25% equity + 75% fixed income fund. Additionally, two tests for robustness of the MARF are shown: A "Lower Range" and the "Stress Test". The latter considers the case when the correlation between assets goes to 1. The former uses the low end of our estimate for expected returns and the high end of our estimate for volatility.

Optimization of MARF allocation strategies results in enhanced financial performance while accruing economic development benefits

Based on extensive stakeholder meetings with pension funds, credit agencies, and asset managers, a computational framework was developed for rating the risk of a Multi-Asset Renewal Fund that is relatable

Figure 7.29
VaR for MARF relative to hypothetical funds, and robustness tests



to the target long-term institutional investors of the MARF. The approach is highly quantitative, thus ensuring that it can be applied to different fund designs while yielding consistent results.

Bearing in mind the current performance of Finnish pension funds, and indeed pension funds around the world that are starting to look at increased allocations to multi-asset funds and private credit vehicles, the MARF is exceptionally well-positioned. The MARF results for the private credit (35%)/private equity (10%)/ETF (15%)/climate bond (40%) allocation strategy, show a return of 6% (Figure 7.26). This is similar to the current performance of Finnish pension funds. However, the Smart Mobility MARF accomplishes this at a VaR similar to high-yield fixed income products, and without government subsidies or first loss instruments.

Fund optimization. Now that the risk and return profiles of MARFs are well-understood, and stress testing of the fund showed a robustness in the face of correlation between the assets, an optimized allocation strategy was devised. First, the constraints needed to be set, whereby the value of each asset was marked between 0.5% and 4% of the entire value of the fund. Further, we allowed the allocation to each asset class to vary as follows:

- Private Equity: Must make up 10–40% of the fund
- SME Debt: Must make up 20–40% of the fund
- Public Equity: Must make up 10–20% of the fund
- Climate Bonds: Must make up 15–45% of the fund

The annual returns used in the portfolio optimization were estimated using a Monte-Carlo simulation. Asset values were assumed to follow Brownian motion based on historical volatility and correlation with other assets. The simulation is run for a 52-week duration, with weekly time steps, and 10 million trials per individual asset. The weights of each asset and asset class were then varied as indicated earlier to achieve an efficient return for the portfolio based on these expected annual returns.

> Box 7.5
> **Sharpe Ratio**
>
> A risk-adjusted measure of return used to evaluate the performance of a portfolio. It represents the average return earned in excess of the risk-free rate per unit of volatility or total risk. The higher the value, the better the performance. The ratio tends to work best for fully liquid assets.

The results from the MARF optimization (Figure 7.30) indicate that a minimum volatility portfolio is dominated by climate bonds (45%) and SME debt (33%), and is expected to generate a target return of 7.7%. A maximum **Sharpe ratio portfolio** is dominated by bonds (45%), SME debt (26%), and public equities (19%), and was calculated to generate a return of 10.5%. These returns are gross, and expense ratios of up to 1.5% AUM need to be taken into account. It should be noted that these returns did not take into account government subsidies or first loss mechanisms on the SME debt, as detailed in Chapter 6.

Government first loss guarantee. The impact of the government de-risking strategies on debt was not separately investigated in this work, but is expected to have a dual effect on the performance of the fund. Guarantees would be treated as a 'cash asset' for the fund, as it de-risks debt defaults. By reducing volatility risk – even if only to part of the fund – the likely impact will be a decrease in returns as well. However, this mitigating effect will allow for an increase of capital al-

Figure 7.30
Portfolio weight contributions in each asset class to generate expected returns from the Smart Mobility MARF

locations to the private credit asset class, and potentially to private equity as well. The increased allocation to these asset classes will increase the VaR, as was shown in Figure 7.30, but this risk will be mitigated by first loss mechanisms. Hence, the return estimates could well increase to 14% across the MARF portfolio, while over 70% of capital is allocated to long-term investments, as will be expected for an ELTIF investment vehicle.

The risk and return profile fits the investment mandate and fiduciary requirements for long-term investors, and the process is structured and semi-automated to help build the trust and familiarity of financial managers with this fund. Whether the trustees of pension funds, and managers of sovereign wealth funds, will consider including MARFs in their investment portfolios depends on the engagement of policy makers in the replumbing of the financial markets, and of experienced fund managers across the asset classes comprising the fund.

Box 7.6
A MARF for long-term investors?

This performance assessment demonstrated that the MARF design – and the financial technology that enables this type of fund – will meet its goal of a green long-term investment vehicle for pension funds and other institutional asset managers, by merging financial returns with investments in the real economy.

References

1 Lustig, Y. (2013). Multi-Asset Investing: A Practical Guide to Modern Portfolio Management 1st ed., Harriman House.

2 Crouhy, M., Galai, D. & Mark, R. (2000). A comparative analysis of current credit risk models. Journal of Banking & Finance, 24(1), pp. 59–117.

3 Jorion, P. (2006). Value at Risk: The New Benchmark for Managing Financial Risk 3rd ed., McGraw-Hill Education.

4 Ang, A. & Sorensen, M. (2012). Risks, returns, and optimal holdings of private equity: A survey of existing approaches. The Quarterly Journal of Finance, 2(03), p.1250011.

5 Heed, A. (2010). Regulation of private equity. Journal of Banking Regulation,12(1), pp. 24–47.

6 Chertok, S. & Braendel, A. D. (2010). Closed-end private equity funds: A detailed overview of fund business terms, part I. The Journal of Private Equity, pp. 33–54.

7 Fang, L., Ivashina, V. & Lerner, J. (2015). The disintermediation of financial markets: Direct investing in private equity. Journal of Financial Economics,116(1), pp. 160–178.

8 European Venture Capital Association (2013). Risk Measurement Guidelines. Available at http://www.investeurope.eu/media/10083/evca-Risk-Measurement-Guidelines-January-2013.pdf. Accessed 03152016.

9 Anson, M. (2013). Performance measurement in private equity: Another look at the lagged beta effect. The Journal of Private Equity, 17(1), p. 29.

10 Emery, K. M. (2003). Private equity risk and reward: Assessing the stale pricing problem. The Journal of Private Equity, 6(2), pp. 43–50.

11 Anson, M. (2002). Managed Pricing and the Rule of Conservatism in Private Equity Portfolios. The Journal of Private Equity, Vol. 5, No. 2: pp. 18–30.

12 Anson, M. (2007). Performance Measurement in Private Equity: Another Look. The Journal of Private Equity 10 (3): 7–21.

13 Scarpati, F. & Ng, W. (2013). What Really Drives Risk Premium and Abnormal Returns in Private Equity Funds? A New Perspective. The Journal of Private Equity, Fall 2013. Available at Available at SSRN: http://ssrn.com/abstract=2310096

14 Korteweg, A. & Sorensen, M. (2010). Risk and return characteristics of venture capital-backed entrepreneurial companies. Review of Financial Studies, 23(10), pp. 3738–3772.

15 Ljungqvist, A. & Richardson, M. (2003). The cash flow, return and risk characteristics of private equity (No. w9454). National Bureau of Economic Research.

16 Rosenberg, B. & Guy, J. (1995). Prediction of beta from investment fundamentals. Financial Analysts Journal, 51(1), pp. 101–112.

17 Damodaran, A. (2012). Investment valuation: tools and techniques for determining the value of any asset. Hoboken, N.J., Wiley.

18 Damodaran, A. (2008). What is the risk free rate? A Search for the Basic Building Block. A Search for the Basic Building Block (December 14, 2008).

19 Damodaran, A. (2015). Equity Risk Premiums (ERP): Determinants, Estimation and Implications – The 2015 Edition. Available at SSRN: http://ssrn.com/abstract=2581517

20 Damodaran, A. (2005). Marketability and value: Measuring the illiquidity discount. Available at SSRN 841484.

21 PWC (2015). Equity Market Risk Premium (EMRP) on the Finnish stock market.

22 Longstaff, F. A. (1995). How much can marketability affect security values? The Journal of Finance, 50(5), pp. 1767–1774.

23 Wehinger, G. (2012). Bank deleveraging, the move from bank to market-based financing, and SME financing. OECD Journal: Financial Market Trends, 2012(1), pp. 65–67.

24 Basel Committee on Banking Supervision (2014). Basel III Leverage Ratio Framework and Disclosure Requirements. 2014. Available at http://www.bis.org/publ/bcbs270.pdf

25 European Central Bank (2015). Survey on the Access to Finance of Enterprises in the Euro Area.

26 Standard & Poor's Ratings Services (2014). Mid-Market Funding in Europe is Making Strides, But Has Far To Go. April 2014, Available at www.standardandpoors.com/ratingsdirect. Accessed 03122016.

27 Nassr, I. K. & Wehinger, G. (2014). Non-bank debt financing for SMEs. OECD Journal: Financial Market Trends, 2014(1), pp. 139–162.

28 Berger, A. N. & Udell, G. F. (1998). The economics of small business finance: The roles of private equity and debt markets in the financial growth cycle. Journal of Banking & Finance, 22(6), pp. 613–673.

29 Rajan, A. (2015). The Rise of Private Debt as an Institutional Asset Class. September 2015. Available at http://www.icgam.com/SiteCollectionDocuments/Rise of Private Debt as an institutional asset class Amin Rajan GENERIC.pdf. Accessed 03122016

30 Lehmann, B. (2003). Is it worth the while? The relevance of qualitative information in credit rating. The Relevance of Qualitative Information in Credit Rating (April 17, 2003). European Financial Management Association.

31 Beaver, W. H. (1966). Financial ratios as predictors of failure. Journal of accounting research, pp. 71–111.

32 Altman, E. I. (1968). Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. The journal of finance, 23(4), pp. 589–609.

33 Altman, E. I., Haldeman, R. G. & Narayanan, P. (1977). Zeta tm analysis a new model to identify bankruptcy risk of corporations. Journal of banking & finance, 1(1), pp. 29–54.

34 Altman, E. I. & Sabato, G. (2007). Modeling Credit Risk for SMEs: Evidence from the US Market. ABACUS Vol. 43 (3), pp. 332–357.

35 Altman, E. I., Giannozzi, A., Roggi, O. & Sabato, G. (2013). Building SME rating: is it necessary for lenders to monitor financial statements of the borrowers? BANCARIA, 10, pp. 54–71.

36 Altman, E. I., Sabato, G. & Wilson, N. (2008). The Value of non-financial information in SME risk management. Available at SSRN 1320612.

37 Breiman, L. (2001). Random Forests. pp.1–33. Available at https://www.stat.berkeley.edu/~breiman/randomforest2001.pdf. Accessed 03152016.

38 Geurts, P., Ernst, D. & Wehenkel, L. (2006). Extremely randomized trees. Machine learning, 63(1), pp. 3–42.

39 Freund, Y. & Schapire, R. E. (1997). A Decision-Theoretic Generalization of On-Line Learning and an Application to Boosting. Journal of computer and system sciences 139, pp. 119–139.

40 Picard, R. R. & Cook, R. D. (1984). Cross-validation of regression models. Journal of the American Statistical Association, 79(387), pp. 575–583.

41 Freedman, D. (2005). Statistical Models: Theory and Practice. Cambridge University Press.

42 Fawcett, T. (2006). An introduction to ROC analysis. Pattern Recognition Letters, 27, pp. 861–874.

43 Kozhemiakin, A. (2007). The risk premium of corporate bonds. Journal of Portfolio Management, 33(2), p. 101.

44 Longstaff, F. A., Mithal, S. & Neis, E. (2005). Corporate Yield Spreads: Default Risk or Liquidity? New Evidence from the Credit Default Swap Market. The Journal of Finance 60 (5): pp. 2213–2253.

45 O'Sullivan, A. & Sheffrin, S. M. (2003). Economics: principles in action, Needham, MA: Prentice Hall.

46 European Investment Bank (2015). Climate Awareness Bonds. European Investment Banks. Available from: http://www.eib.org/investor_relations/index.htm. Accessed April 23, 2016.

47 Climate Bonds Initiative (2015). Bonds and Climate Change. The State of the Market in 2015. Climate Bonds Initiative. Available at https://www.climatebonds.net/resources/publications/bonds-climate-change-2015. Accessed April 14, 2016.

48 Climate Bonds Initiative (2016). Taxonomy. Climate Bonds Initiative. Available at https://www.climatebonds.net/standards/taxonomy. Accessed March 25, 2016.

49 Financial Times, Definition of Sukuk (Islamic Bonds). Financial Times. Available at http://lexicon.ft.com/term?term=sukuk-(islamic-bonds). Accessed April 25, 2016.

50 FINRA, Bond Yield and Return. FINRA.Org. Available at http://www.finra.org/investors/bond-yield-and-return. Accessed March 29, 2016.

51 Gastineau, G. L. (2010). The exchange-traded funds manual (Vol. 186). John Wiley & Sons.

52 Ferri, R. A. (2011). The ETF book: all you need to know about exchange-traded funds. John Wiley & Sons.

53 Poterba, J. M. & Shoven, J. B. (2002). Exchange traded funds: A new investment option for taxable investors (No. w8781). National Bureau of Economic Research.

54 Shin, S. & Soydemir, G. (2010). Exchange-traded funds, persistence in tracking errors and information dissemination. Journal of Multinational Financial Management, 20(4), pp. 214–234.

55 Markowitz, H. (1952). Portfolio selection. The journal of finance, 7(1), pp. 77–91.

56 Maier, S. F., Peterson, D. W. & Vander Weide, J. H. (1977). A Monte Carlo investigation of characteristics of optimal geometric mean portfolios. Journal of Financial and Quantitative Analysis, 12(02), pp. 215–233.

57 Esposito, M. (2016). The dynamics of volatility and correlation during periods of crisis: Implications for active asset management. Journal of Asset Management, 17(3), 135–140.

8

Roadmap

'The Finnish Model' – A Vaunted Investment Strategy for Green Industrial Renewal

'The Finnish Model' – A Vaunted Investment Strategy for Green Industrial Renewal

> *A policy that doesn't acknowledge reality has never succeeded in the history of the world.*
>
> – Sam Zell, Chairman, Equity Group Investments

Multi-Asset Renewal Funds combine technology with blended finance

The execution of the vision for this project – to design efficient market-driven investment instruments that bridge the fiduciary responsibilities of long-term institutional investors with the demands of shifting industrial ecosystems – is a major challenge from a technical, legal, and (industrial) policy perspective. Remember that one of the objectives of the FiDiPro project was to understand how pension funds could be engaged in investing in the real economy in general, and a green economy in particular.

As a first step, we needed to understand the scope of the problem, hurdles, perceptions, risk and return profiles of pension funds, and their 'likelihood to experiment' with new fund types. Our meetings with various Finnish pension fund CIOs, Directors or Alternative investments, and asset managers in banks uncovered a number of guiding insights:

1. Finnish pension funds were at tipping points, where long-term liabilities were starting to outstrip growth of the fund, thus necessitating search for new alpha or beta
2. Alternatives were the clear return drivers for the funds, but the question was open as to what type of asset funds could be allocated to.
3. Real estate and limited commitments to private credit were a potential option, but infrastructure was not viewed as being attractive, in part because limited long-term ownership/revenue structure options
4. Investment needed to be longer term and passive, and should not follow a 'policy fad' like Cleantech. If it is not market driven, the political risk for sustained alpha is too high.

5 Most investment in publicly traded companies was directed at global, not domestic, equities

6 Government and corporate bonds in the current climate were not attractive because of the minimal interest spread, making investments in the real economy (e.g. credit) potentially attractive, but not significant enough to make a difference.

Given these inputs, and to navigate the competing topic of designing of the project's stakeholders – including financiers, risk managers, policymakers, rating agencies, and asset managers – we started the fund structuring process with a Lego® Serious Play® ideation session. According to the company's website:

> "The LEGO® SERIOUS PLAY® methodology is a radical, innovative, experiential process designed to enhance business performance. […] By using the LEGO® SERIOUS PLAY® materials and methodology you will explore the relationships and connections between people and their world, observe the dynamics both internal and external, explore various hypothetical [business] scenarios, and gain awareness of [business opportunities]."

The Lego® tools and methodology – intended to help innovative teams in corporate boardrooms visualize abstract concepts in structured strategic planning sessions – were adapted to engage a broad-based team in the highly technical discussions associated with economics and finance. Our ideation team consisted of equity and industry analysts, supply chain experts, micro-economists, management consultants, and academics with background in finance, strategy and entrepreneurship.

Many of the original concepts and key differentiators of the Multi-Asset Renewal Fund started with the building blocks

The team was challenged over a three-week period – using individual and team-based sessions – to address a robust set of questions on the topic of designing an investment instrument that has the required (low) risk profile, sufficient liquidity, and scale for pension fund investment allocations, with impact on the real economy. Specifically, the participants were asked to explore the:

1 Differences in capital structure and business model elements of companies across the business cycle (startups, small and medium enterprises, publicly listed companies)

2 Fiduciary requirements, expected risk-return profiles, and roles of investment actors across the financing value chain (government, lenders, equity investors, pension funds)

3 Necessary information flow within the organizational management of a hypothetical multi-asset fund structure comprised of liquid and illiquid asset classes.

The visualization (Figure 8.1) captures the outcome of the ideation sessions, at macro- and microlevel detail (information on the design and detailed process of these sessions is available upon request). It may seem trite now that the reader had a chance to peruse the preceding chapters, but many of the original concepts and key differentiators of the Multi-Asset Renewal Fund started with the building blocks. The Figure represents – starting clockwise from lower right corner – the value system strategist, and the public equity analyst, the private equity investor, the institutional (pension fund) investor, the SME private credit analyst, the risk assessor (actuarial), and the portfolio (fund) manager. Let us explore the learnings from the ideation sessions in further detail and connect them to the ultimate MARF design and risk:return profile.

Value system strategist. Per the definition of industrial renewal, emerging industry ecosystems leverage economic assets, trade relationships and technology innovation, and thus falls squarely in the realm of strategy, foresight, and future trend analysis. Hence, the design of an investment instrument that builds on legacy assets, while integrating new growth assets, requires the expertise and knowledge of industry meta-analysis. This is represented by the four cardinal directions – and the economic activity in each – in the figure, supplemented by the bird's eye view that can be pivoted in any direction to recognize value. How do disparate value chains get connected? How can we begin to under-

Figure 8.1
Visualization output of Lego® Serious Play® ideation session focused on MARF design

Figure courtesy of Sven Adriaens.

stand whether incipient trends in disconnected industries will become value- (and jobs) generating components of an economy? The enlightened reader will recognize that this insight led to the development and implementation of financial network mapping, and the application of network theory to recognize anchor and catalyst industries, as described in Chapter 3.

Public equity analyst. Publicly-traded companies are the core of most economies. Due to their size and diverse lines of business, they are the job creators, major contributors to economic development, and the suppliers or customers of complex supply chains. These supply chains include most private companies, including innovative growth companies and startups who unbundle their offerings and contribute to their efficiency in the market place. The figure recognizes that public companies are often protected or favored by policies, receiving subsidies and tax breaks, and – in Europe and Asia – government control of their share structure (represented by the cam wheels impacting management and operations). They are often national champions. We recognize that they are key players in the meta-industry system, because they source innovations from across the universe of industry codes, particularly those heavily dominated by information technology. This insight led to the development and refinement of a KeyStone Compact® Enterprise® version of the algorithmic business assessment tool described in Chapter 4.

VC/PE investor. Private equity companies and their portfolio companies play a key role in the diversification of investment funds. In the ideation exercise, the emphasis was on the role of these companies as the high value-high growth companies that dot the landscape in many industry sectors, but nowhere more than in the technology sector. The reason is their scalability, capital efficiency, and important role as contributors to the 'platformization' of many industries. The periscope in the figure is indicative of the long-term disruptive view of these companies and their investors, while the ladder and the glass pillars denote the high risk and uncertainty associated with these companies. Given these risks, the team understood that the fund could not be designed to hold the lead investor position in these companies, but would serve as a co-investor in venture and private equity funds. These high risk ventures would be outside the perimeter of the fund, but co-investments would serve to boost returns at a safe distance, as per the MARF structure laid out in Chapter 6.

Institutional investor. Intended to represent the pension fund investor, the 'layer cake' tower represents the multitude of different asset classes in the portfolio of the fund. Described in Chapter 6 as fiduciary management, the CIO or head of alternative assets (though we were not yet aware that a MARF would be classified as an alternative investment) is connected to the various buy-side asset managers that need to adhere to – and perform in accordance with – risk and return specifications set by the actuaries and the trust. The pension fund was viewed as a rather passive manager, focused on long-term holdings and growth strategies, as signified by the hose taking in the returns. Hence, the ideation team – in structuring the fund – emphasized the need for diversification, but also long-term capital commitments, leaving investment decisions to asset managers (Chapter 6).

SME private credit analyst. The team had a solid understanding of the role of SMEs as an innovator in traditional and emerging value chains. The limited leveraging opportunities of SMEs *vis* à *vis* the corporate (public) customers, means that they often have to innovate against tight deadlines and marginal cost. Whereas this places SMEs sometimes at a disadvantage in established supply chains – where cost-optimization has been maximized – they have an advantage when new supply chains emerge, with a first-to-market solution. Hence, SMEs are very diverse, ranging from traditional cash-flow driven businesses, to those with the potential for high growth and value capture. Whereas the cam wheels represent the grind of day-to-day business driven by working capital loans, the see-saw in the background symbolizes SMEs in a negotiating position with partners as they attempt to reposition themselves, both reflecting the spectrum of businesses. These insights helped us design the KeyStone Compact® SME® tool, to differentiate between companies with variable market paths. Moreover, following this discussion and recent reports on alternative investment models for SMEs, we were fully committed to start exploring how government guarantees could be deployed to jump start the private credit investment option.

Risk assessor. Risk assessment and risk mitigation are integral to any investment vehicle, and are more complex as the complexity of the instrument increases. The team wrestled with the challenge of integrating liquid and illiquid asset classes, comprised of underlying assets that have highly variable business models, outlook, and financial performance. Whereas plenty of tools are available for publicly traded securities (stocks, bonds, listed infrastructure), the arsenal of risk frameworks for private companies are limited, and are often constrained to credit risk reports or public proxy analysis. Even if the risk assessment strategies exist for separate asset classes, there are no established methodologies to integrate the risks of liquid and illiquid assets. These insights led us to the emphasis on uncovering trends and insights from KeyStone risk profiles – reflecting non-financial risk – and integrate these with financial risk metrics, as reflected in the 'spider structure' in the figure, connected to all asset classes. Moreover, the bespoke analysis of risk required for a Multi-Asset Renewal Fund motivated us to commission a team of finance students from the Ross School of Business with a strong background in data mining and uncertainty analysis to develop a risk assessment and allocation optimization tool (Chapter 7).

Portfolio manager. Considering the complexity of the fund, and the mix of different asset classes, we had been asked by members of our steering committee what the governance structure of this type of fund would (need to) be. The response to this question evolved during the three weeks of the ideation session, as it became clear to us that the risk profiles and the data availability (daily to monthly) of the underlying assets necessitated different management approaches for each asset class. In fact, we conceptualized that the private credit asset class itself was very diverse, given the potential for high growth potential companies, among the solid but staid cash-flow generators. Thus, it dawned on us that the management of a fund like this would require separate managers for each asset class, as well as a portfolio manager overseeing all asset classes, and engaging with the pension fund investors. The diversity of likely skill sets required to make this fund run and perform as intended was daunting, as reflected by the three types of feeds (asset classes), and need to 'fence off' and separate each asset class manager to avoid conflicts.

A fund like this would require separate managers for each asset class

Following the ideation session, a draft document was developed and circulated widely, and further refined in consultation with experts at global investment banks and with Finnish stakeholders. The due diligence work of the preliminary fund structure with practitioners in the field was extremely helpful, and helped us gain an understanding of the limitations and constraints that would be required to implement this investment structure. A sampling of responses and engagement is articulated below.

Governance structure. A face to face meeting with asset managers from Deutsche Bank (London) resulted in a complete deconstruction of the fund, and implementation of conditions for its management and offering. For example, it was made clear that the mix of assets rendered the fund very unwieldy, unless it would be structured as a closed-end fund with minimum lock in requirements, and separate asset managers for each asset class. We were forewarned that a MARF structure would need to keep significant cash on hand given the probability of default on debt, and capacity to respond to capital calls from the private equity funds where the MARF is a co-investor. The first loss guarantee was viewed as a positive element, as was the de-risking of the fund using climate bonds and ETFs, given their high liquidity.

SME capital structure risks and equity opportunities. A meeting at HSBC (London) revealed the breadth and diversity of loan types and risks in a bank's portfolio, yet indicated that banks are interested in uncovering potential high growth ('antelopes') equity-investable companies among their leveraged credit loans. The challenge is to tease out these SME transitioning opportunities and understand their non-financial as well as financial risks.

MARF structure may fit European Long Term Investment Fund (LTIF). A seminar at the headquarters of KBC Wealth Management (Brussels) with legal experts and fund administrators revealed that the MARF may fit the criteria of the LTIF, which was approved by the European Commission in April 2015, or an insurance fund. The key is long-term holding and high proportion of illiquid assets invested in the real economy (projects, infrastructure, SME credit). A strong argument was made for registration in Luxemburg, given its appetite for alternatives.

MARF industry ecosystem investing is attractive to economic developers. The structure and investment thesis of the fund was presented at three investor meetings (Singapore; Taipei, Taiwan; Lausanne, Switzerland) led by the Global CleanTech Cluster Association, a Swiss-registered Foundation with the mandate to build out green value systems globally. With members in 27 countries and 54 economic development clusters, representing nearly 10,000 companies, the GCCA has its finger on the pulse across the globe. Feedback from economic development groups, many of whom have been focused on industry cluster building in their local areas of strength, indicated the need to bridge the language gap towards pension and insurance funds. The net result is that we are building MARFs – designed in Finland – in Switzerland and Taiwan, with strong support at Ministerial level.

Deployment size for pension funds is € 250–500M. Fund discussions with Deutsche Bank and the P80 Foundation (representing the world's 80 largest pension funds) revealed a minimum size required for capital allocations in the MARF for it to return the intended profit. This size is in part dictated by the minimum capital allocations made by large cross-border funds, and in part by the management costs and expense ratios of a complex fund like this. We were recommended to make all efforts to minimize back office costs, for example by using digital fund management platforms (e.g. CrowdValley).

Industrial investment policies that integrate Multi-Asset Renewal Funds help public funds efficiently unlock private capital for economic development

Industrial renewal has been on the European and North American policy agendas for years as competition from the emerging economies and rapid technological change have rendered the competitive edge of many established companies and clusters obsolete. To add to the pressure, the need to find environmentally and socially sustainable approaches to production and consumption has garnered global, consensual recognition, increasing the urgency for systemic renewal across the industrial landscape.

Turning the ship has proven difficult; the tugs are running out of fuel

The financial crisis has further aggravated the situation in several ways, particularly in Europe. The deep economic slump resulted in structural mass unemployment, leading to the degradation of skills in key segments of the labor force. Business investments plummeted and have remained at a low level, given the weak demand prospects and troubles in financial intermediation. In parallel, spending on corporate R&D has been reduced as well. All these factors have contributed to significant downward revisions of output potential estimates in Europe; and to make things worse, the actual output remains well below these estimates.

Turning the ship has proven difficult; the tugs are running out of fuel. Badly deteriorated public finances have reduced the scope of traditional policy approaches in promoting investments and renewal. Public investments in infrastructure have been slashed and can hardly be increased significantly in the near future, as debt reduction will remain a key objective in most EU countries. Without saying, the same is true for direct subsidies and tax breaks for private investments.

In this context of both a heightened need for industrial renewal and a reduced scope for employing public funds for the purpose, it is an imperative to find effective ways to leverage those public funds that are still available – as limited as they may be – to kick-start and reform the economy. A number of EU-level initiatives have already seen the light of day. Alongside the targeted long-term refinancing operations launched by the European Central Bank, the European Fund for Strategic Investment by the new EU Commission (EFSI or the "Juncker plan") is the most prominent manifestation of this policy momentum. The plan aims at inducing private investments worth € 315 bn. by using some € 21 bn. EU funding and guarantees in a three-year window.

Thanks to the exceptionally expansive monetary policies in Europe as well as in other parts of the developed world and the low current level of investment, there are lots of idle financial resources waiting to be mobilized. This would suggest that well-designed policies could unlock substantial investments. Still, the EFSI initiative plan has been heavily criticized on two counts: first, for an unrealistic leverage ratio (1:15) of public and private investment injections, and second for the potentially very inefficient selection of projects to be financed.

To address these problems, one should be able to design a scheme where (1) the limited public funds help in an efficient way to unlock investment opportunities with optimal risk-return profiles for diverse private investors to drive industrial renewal, and (2) the projects and the companies to be financed are selected in an efficient way given the always imperfect information about the prospects of individual projects and the combined effects of many adjacent activities in terms of growth and job creation.

The task is one of clever financial engineering.

We believe that the Multi-Asset Renewal Fund investment approach offers insights that could be helpful in designing the looked-for investment scheme in the European context. Rather than starting from a long list of separate candidate investment projects, it first seeks to identify investable new industrial value systems and then, given these value systems, sets out to design – with a limited support of public sector risk-bearing – a set of investment instruments which would best match the preferences of different types of investors. A key advantage for industrial investment policy design, is that the MARF helps to maximize the impact of public funds given varying – and sometimes contradictory – objectives for private investments, leverage of public funding, economic growth and job creation.

Pension fund policies should allow Multi-Asset Renewal Funds to generate alpha in their investment strategies, while greening the economy

Pension systems are long-term investors, seeking to meet financial obligations that extend over decades and generations. Indeed, because pension plans are rarely terminated, and because the plan sponsors rarely go out of business, these obligations are virtually perpetual in nature. Even so, pension trustees are often pressured to respond to short-term market fluctuations, to react to the daily noise of the capital markets, and to be seen as “doing something” by other stakeholders that have an interest in the plans. Given these conflicting pressures, the development of an investment policy is crucial to maintaining a long-term focus.

The search for yield by pension funds is increasingly including the integration of alternative assets

We have noted in Chapter 6, and have discussed with stakeholders, that the search for yield by pension funds is increasingly including the integration of alternative assets. With private equity the main component, hedge funds, real estate and infrastructure income, and private credit are on the rise. Despite these allocation shifts, it does not appear that EU pension funds in general, and Nordic pension funds in particular, are gaining in their asset allocation to alternatives, relative to the US. One of the challenges noted by practitioners and the literature is the lack of familiarity within the pension fund with new instruments, resulting in very small allocations to these assets. A second challenge is that the alternative asset instruments with the right scale and liquidity to meet long-term liabilities have not been available.

The approval of ELTIFs in 2015 to stimulate investment in the real economy through infrastructure and SME investments has changed the landscape of alternatives. It is our understanding that individual EU governments yet have to explore how these types of funds can be integrated in the investment strategies of pension funds. If we look at what is happening with Finnish pension funds, we see climate bonds and private credit becoming part of the scope of investment strategies. Unfortunately, these investments are inefficient, as they require piecemeal allocations. Yet, the appetite is there. Multi-Asset Renewal Funds address a number of the limitations in the current market of funds: (i) they are of sufficient scale (see earlier comment from P80 Foundation and Deutsche Bank); (ii) they are diversified with sufficient liquidity and long-term holding times, attractive to pension funds (comment from Deutsche Bank and KBC Wealth Management); (iii) they effect economic development at enhanced market returns (Chapter 7); and (iv) they have the capacity to renew entire clusters and industries, while leveraging existing assets (comment from GCCA clusters).

One of the key innovations of MARFs is that they engage public capital in a manner that de-risks the loan asset class for SMEs

One of the key innovations of MARFs is not only that the underlying assets are efficiently sourced, and vetted using non-financial and financial metrics, but that they engage public capital in a manner that de-risks the loan asset class for SMEs. Blended capital investment funds that have the returns of private equity with the risk of corporate bonds exhibit the best of both worlds, and fit within the risk profile of pension fund investment strategies. The fact that they fit within an already approved fund structure to boot should be an incentive for governments and pension fund policies to adopt the fund as a 'new' alternative asset.

Strategic insights for Nordic Cleantech

The clear focus of the book has been on the MARF as a novel investment vehicle for industrial renewal and economic development. That being said, the design process for constructing MARFs generated also a lot of insights into the current state of the Finnish Cleantech space – our "wet lab" that we used for developing and testing the MARF. It would be a waste of perfectly good, hard-earned wisdom if we did not wrap up the book by providing you with a concise summary of key implications for a strategic roadmap to promote both value capture and investability in the Finnish Cleantech space.

Now, implications for the Green Chemistry ecosystem were abundantly dealt with in Chapter 3. You will remember, rigid vested interests between the petro chemicals industry and the specialty chemicals industry call for a policy intervention for more sustainable solutions to break through and establish themselves. In the final sections of this chapter, we therefore concentrate on providing you with strategic implications for the remaining two ecosystems covered earlier in this book, namely Smart Grid and Smart Mobility.

A global, economically viable Smart Grid ecosystem is a reality

Smart Grid enterprises need more aggressive entry strategies to avoid marginalization

Our results confirm that a global, economically viable Smart Grid ecosystem is a reality. Power utili-ties, electrical and mechanical component and systems manufacturers, information and communication technology producers as well as telecommunications operators form a strong infrastructure layer that provides the physical foundation for the entire Smart Grid ecosystem. This foundation integrates power generation technology, transmission and distribution grids, the respective electronic and mechanical equipment as well as telecommunication grids and their control technology.

On top of the foundation, data and software -driven companies build scalable, fast growing businesses, leaning on the resources of the entire infrastructure layer. In doing so, cross-industrial value chains emerge and enable the creation of service models that add new value in the form of improved efficiency, reliability and flexibility. It is these companies that connect the involved legacy industries to form the emerging ecosystem and to make it "smart". IT-hardware developers, data storage companies, application and systems software developers, as well as data processing and analytics companies are in this growing nexus of the Smart Grid ecosystem. Machine-to-machine communication -enabled grid and facility automation, remote controlled smart homes and factories, micro-grid integration, demand response optimization, and predictive grid maintenance services are just few examples of new value added products and services powered by IT- and software-driven solutions.

How do Finnish companies fare on this stage? Given the well-publicized strengths of the Finnish industry structure, one would argue that the odds are in the country's favor.

In the infrastructure layer, Finland has a long-standing legacy in power electronics and mechanical engineering with a particularly live-ly, international cluster centered around the Westerly located city of Vaasa. Furthermore, Finnish power utilities had to face the open and competitive electricity market amongst the first in the world as the electricity markets were liberalized in Scandinavia as early as the mid-1990s. In a sense, they have had a head start in designing competitive strategies and adopting smart solutions to stay at the edge in the highly commoditized market place.

The incumbent players in the infrastructure layer of the Smart Grid ecosystem have adopted a non-aggressive entry strategy

Many of the same arguments apply to the Finnish telecommunications sector. With the rise of Nokia driving an explosive national and global adoption rate in mobile telephony in the same time period, the Finnish telecommunications operators faced a fast growing market place that was gagging for ever larger bandwidths and smarter services such as journey planners, digital tickets for public transportation and other flexible on-the-go solutions that helped make everyday life more efficient, less stressful and spontaneous. They, too, have had time and incentives to respond to a very demanding clientele that expected smart solutions from the start.

However, our results show that the incumbent players in the infrastructure layer, despite their robust position to capture value from the Smart Grid ecosystem, have adopted a non-aggressive entry strategy. Their strong value capture position is encumbered by capital intensive, manufacturing-driven, production business models that are difficult to scale rapidly. Instead of strategically positioning themselves into the high-growth sectors of the Smart Grid ecosystem, Finnish enterprises have continued to provide their incumbent and highly commoditized products and services – such as electricity by the kilowatt-hour and data transfer by the megabyte – to the ecosystem. These commodities are important, no question, but the attractive margins and growth in value are in the scalable services and related products that help customers save costs through digital optimization and predictive maintenance, improve the comfort of living through home automation and user interaction, as well as improved risk management through self-healing grid technologies and intelligent security solutions. Continuing to rely on commoditized and generic product and market strategies puts enterprises in danger of becoming marginalized and being pushed to the periphery of the ecosystem. They will still remain vital as the producers of the necessary core commodities, but the value will be captured by companies in the growth sectors of the system.

Reliance on commoditized and generic product and market strategies puts enterprises in danger of becoming marginalized

What can power utilities, component manufacturers and telcos then do to reposition them for improved value capture and growth?

In the US, some telcos have been particularly aggressive. Verizon, for instance, has invested into its own energy production capacity, and now powers its own facilities. Verizon hardly competes with energy utilities for a share in the regulated commodity business, but uses investments to learn about the dynamics and technologies of renewable energy generation, grid integration, micro- and off-grid technology, power distribution, demand response optimization and consumption prediction. It is a test laboratory in Verizon's own backyard that enables the company to develop and adopt an entirely new skillset for providing cutting-edge solutions without the historical baggage of legacy companies that are too slow to capture value in the Smart Grid ecosystem. At the same time, the company benefits from the goodwill their sustainable and independent energy setup imparts on the Verizon brand.

There is an acquisition frenzy sweeping across the Smart Grid landscape

Less aggressive strategies build on acquisitions. Again, US contenders are more courageous in the adoption of this strategy. Many of the companies pictured earlier in Figure 4 do not exist anymore because they have been bought out by peers, suppliers or customers in both horizontal and vertical acquisition strategies. There is an acquisition frenzy sweeping across the Smart Grid landscape as companies across industry boundaries compete for the largest piece of the still growing Smart Grid pie.

But why would companies make such risky commitments in face of the still somewhat vague economic promises made by Smart Grids? Isn't partnering, for instance, a more flexible and less risky option to probe the emerging space?

An acquisition strategy has one major advantage over pure partnering strategies, the least aggressive of options: the buyer internalizes the value the acquiree would otherwise capture from the growing ecosys-tem. In our company analyses we often encountered enterprises that claimed to have committed to be-coming a key provider of Smart Grid solutions. On a closer inspection of their respective business models, however, it turned out that the enterprises' role in these solutions remained that of the conventional commodity provider. At the same time, a number of their partners – sometimes tens of them – contributed all the smart elements and captured their associated value. Sure, large incumbent enterprises can charge a certain margin for their role as an integrator of these elements and for providing a market channel to the often much smaller partners but the dependency on a partner's specialized capabilities in the emerging Smart Grid space compromises this advantage. A lot of potential synergies are left on the table. Furthermore, the appropriation of relevant capabilities, a prerequisite to long-term success in any environment new to a company, is difficult in an arms-length, contractual

Partnering is a justified first step in entering into the Smart Grid ecosystem relationship, in which partners are understandably reluctant to disclose their core capabilities.

That being said, partnering is a justified first step in entering into the Smart Grid ecosystem. It provides consortia of companies the possibility to capture an increasing share of a fast growing market space. Sometimes speed is crucial to the establishment of a competitive position. The objective for corporate consortium partners, then, is to exploit the partnerships to validate potential market opportunities, acquire the required core capabilities for long-term success and aggressively leverage their superior resources to establish their presence in the new market.

Legacy infrastructure and digital market platforms offer improved market access for Smart Grid SMEs

According to our results, startups and SMEs are quicker to tap into the Smart Grid market potential than their large corporate counterparts. Their business models are more scalable and, most decisively, exhibit a much higher capital efficiency. This gives them the capability to capture opportunities faster. Chapter 4 clearly shows that the majority of startups and SMEs is in the lower right quadrant of the investment grade matrix.

The make-and-sell business model, the stalwart of the traditional Cleantech economy, is being eroded by service models

This is a strength worth preserving. As argued in previous chapters, the make-and-sell business model, the stalwart of the traditional Cleantech economy, is being eroded by service models with recurring revenue streams and low capital intensity. CleanTech 3.0 has been defined by business models that have been built on top of legacy infrastructure, and has given rise to the cleanweb. ICT and network-based technologies are at the core of the transition from Cleantech to cleanweb. A decade after Cleantech was defined as an innovation space, the convergence between ICT and Cleantech holds the key to scale and profitability. Given the pre-eminence of Finnish companies in this area, and a rich industry value system in this space, there is clearly an opportunity to be tapped and assets to be leveraged. Our current results imply that SMEs in the Smart Grid space are well positioned to do just that, given their fairly good scalability and excellent capital efficiency.

It is safe to consider the Finnish Smart Grid industry an incipient economic sector

However, both startups and SMEs suffer from the same weakness that seems to be characteristic of the entire ecosystem: poor leveragability of industry capabilities needed to gain access to markets. It is an unfortunate deficiency since there are ample market opportunities to be exploited given the deregulation of the energy industry and diversification in the telco industry. However, the necessary value chains – the cross-industrial structures that we mapped in Chapter 3 – are too undeveloped to sustain growth of a scalable market. It is safe to consider the Finnish Smart Grid industry an incipient economic sector.

There is a need for building out a growing Smart Grid industry cluster and market. As a first step, startups and SMEs could work with large enterprises to address their energy needs. Small firms can leverage the market infrastructure of large enterprises to gain access to the global market place. Therefore, in the short term, a partnering strategy offers a synergetic opportunity that both small and large firms could benefit from. Indeed corporate strategic investors have increasingly turned to the development of corporate incubators with small companies. The objective is to align innovative product offerings with corporate lines of business. In the long-term, however, once the necessary capabilities have been acquired, large enterprises have the incentive to use their asymmetric market power to capture most of the value generated in consortia.

Progress in digital market platforms is a promising venue that helps small companies scale their offering onto global markets

Small and medium -sized companies, therefore, are advised to develop parallel value chain strategies independent of large industry connections. Progress in generic, digital market platforms is a promising venue that helps small companies scale their offering onto global markets without having to lock into market channels controlled by dominant enterprises or having to invest heavily into building costly proprietary market infrastructure.

Partnership programs, cross-industrial pilots and governance standards for networks of IT systems are effective tools in promoting industrial momentum

Our findings give rise to a number of policy recommendations. First, the Smart Grid ecosystem seems to have gathered industrial momentum to grow in a sustainable manner. As shown, a number of conventional legacy industries contribute the necessary commodities and infrastructure for more agile – and often digital – sectors to build new value added services. However, a closer look has revealed a weak connectivity of the companies to appropriate market channels that would allow them to exploit the momentum. As an initial measure, both large enterprises as well as SMEs would benefit from synergetic partnerships that give incumbents access to their specialized capabilities, and provide SMEs with a possibility to leverage the incumbents' superior market infrastructure as a channel.

To accelerate the formation of partnerships, economic developers are advised to favor development vehicles that promote collaboration between enterprises and growth companies. Innovative pioneers in this area already exist. The Nordic Innovation Accelerator (NIA) , for instance, runs a technology and business brokerage program that "invites corporations to bring their innovation needs to be served by a number of startup solutions." For startups, in turn, NIA's program provides "validation for their ideas and products and provides opportunities for funding and acquiring ready clientele." NIA has already successfully brokered partnerships between a number of Finnish startups and global enterprises such as Fortum and Veolia. A similar concept is applied by Vertical Accelerator, a broker of partnerships for growing healthtech companies and large, multinational enterprises such as Samsung, Sonera and Ingram. In addition to the match-making service, Vertical Accelerator actively helps their small clients in developing their technologies and businesses to be ready for adoption by corporate partners.

The power of ecosystem-wide pilots is in that they already assemble viable consortia

Another useful vehicle for the promotion of cross-industrial partnerships is the support of world-class industrial and economic pilots that demonstrate the viability of emerging ecosystems on a believable scale. A great example of an ecosystem-wide demonstration is the Smart Energy Platform as currently launched in Åland. As the consortium behind the pilot states, "the target [of the pilot] is to create the world's most advanced flexible energy system of the future as a Cleantech showcase in Åland, where a fossil free energy system and the whole value chain enabling different flexibilities simultaneously can be demonstrated." The power of ecosystem-wide pilots is in that they already assemble viable consortia – representative of the underlying industrial value chain – that can carry the momentum forward after the completion of the pilot. In a way, large enough pilots give rise to economically viable model ecosystems that can be seen as seedbeds for a larger ecosystem.

Finally, we argued that the fastest growing businesses in Smart Grid revolve around IT- and data-enabled service models (XaaS) that, given the progress in digitalization and machine-to-machine communication, are now available even to more conventional, engineering-driven component and systems manufacturers. The biggest drag on the proliferation of the XaaS model is the lack of a universal governance model for the ubiquitous network of the vast array of diverse and inherently incompatible IT-systems that digitally-enabled services run on. Most of the systems have been developed for a specific, standalone purpose and service. Interconnectivity between the systems has not been an integral nor desired feature at the time of their inception. In XaaS models, integration of IT-systems across entire value chains becomes key as data needs to flow along the chain of suppliers, clients and partners. Lacking a universal governance model, integration be-

The biggest drag on the proliferation of the XaaS model is the lack of a universal governance model for the ubiquitous network of incompatible IT-systems tween systems today is a tedious undertaking, as connectivity needs to be established in a customized, non-scalable, case-by-case fashion.

Scaling of digitally-enabled businesses would see unprecedented rates if a unified governance standard for a network of systems could be established. History has shown that it is possible to introduce standards in a de facto, industry-induced fashion. It is a long, evolutionary road that is usually dominated by the large and often entails unproductive battles over who will set the standard that is adopted widely. On the other hand, history has also shown examples of active, centrally-lead standardization projects. These are a lot faster to set in place and, when designed properly, will not introduce market distortions that favor single stakeholders. Policymakers and economic developers could take decisive action in promoting digital governance standards to pave the way for the quick emergence of cross-industrial service models that will not only help modern IT-businesses thrive but support incumbent, engineering-driven companies reposition their make-and-sell -based businesses models into scalable service models.

Could symbiotic relationships be the way forward for enterprises and SMEs in the Smart Mobility space?

What insights can we draw from the results on the Smart Mobility ecosystem? Clearly, many of the takeaways drawn from the Smart Grid ecosystem apply also here. Both ecosystems show proof of existing industrial momentum; they are also both characterized by an anchor-catalyst industry structure, the emergence of which is driven by data- and software-driven, scalable businesses that lean on the infrastructure provided by large, incumbent industry. To avoid tautology, we focus on the differences between the ecosystems for drawing additional insights.

Large enterprises seem to be exceptionally well positioned to capture value from the Smart Mobility ecosystem

One of the most striking findings is that large enterprises seem to be exceptionally well positioned to cap-ture value from the Smart Mobility ecosystem. They are endowed with the essential assets – both tangible and intangible – to be independent of other actors in the ecosystem, they protect these assets well, and have established effective channels to access the relevant markets. Indeed, large enterprises do not only beat their Smart Grid peers in value capture capabilities but are also clearly ahead of their smaller competitors – startups and SMEs – in the Mobility space. So, what is to stop them from establishing a dominant position in Smart Mobility and to drive and accelerate its development as resourceful actors?

The reason lies in the strategies and business models enterprises have adopted to explore opportunities in Smart Mobility. Bound by legacy business trajectories, enterprises rely on their incumbent, capital-intensive and infrastructure-heavy approaches to explore the new ecosystem. These approaches many times imply high-volume but low-margined business models. These, in turn, translate into low expected profitability and long lags between initial investments and the respective returns. At worst, the companies continue to pursue commodity business models, such as selling data transfer by the megabyte, or transportation by the kilogram or distance. Therefore, to profit from their excellent asset base, enterprises need to redefine their role in the ecosystem and adopt aggressively scalable, capital efficient business models such as those found in the digitalized Xaas domain.

Startups and Smes have a relatively weak value capture position but apply excellent, high-growth business models

Their smaller competition knows how to do it: Startups and SMEs have a relatively weak value capture position but apply excellent, high-growth business models. Their problem is, however, that acquiring the much needed fundamental assets in an attempt to improve their weak position in value chains is a lot harder than merely re-defining strategy and business models. Partnering with incumbents for resources – starting off from such a weak position as it is – might expose SMEs to the danger of being marginalized even further.

That being said, the incumbents do have what SMEs need and cooperation might very well be the only viable option to gain access to markets.

With skill, a viable alternative strategy is to scout those little niches in the capability base of incumbents that they still lack and to exploit the weakness. Specializing in the niches can be a viable strategy to gener-ate revenue for fueling growth and building up required assets to strengthen value capture capabilities. This has been evidenced in the 3rd wave of unbundling, a recent phenomenon that sees small service businesses pick apart the fringes of the generic service offering of incumbents, each focusing on where the individual company's comparative advantage is. Fig. 8.2 lucidly illustrates the phenomenon by way of showing how "startups can successfully take on titans in the home including Philips and Honeywell by attacking them at a product/service level," as CB Insights puts it.

"Startups can successfully take on titans in the home by attacking them at a product/service level"

– CB Insights

What can incumbents do to dodge the fate of being eaten alive by a school of ferocious piranhas? There are to evident avenues:

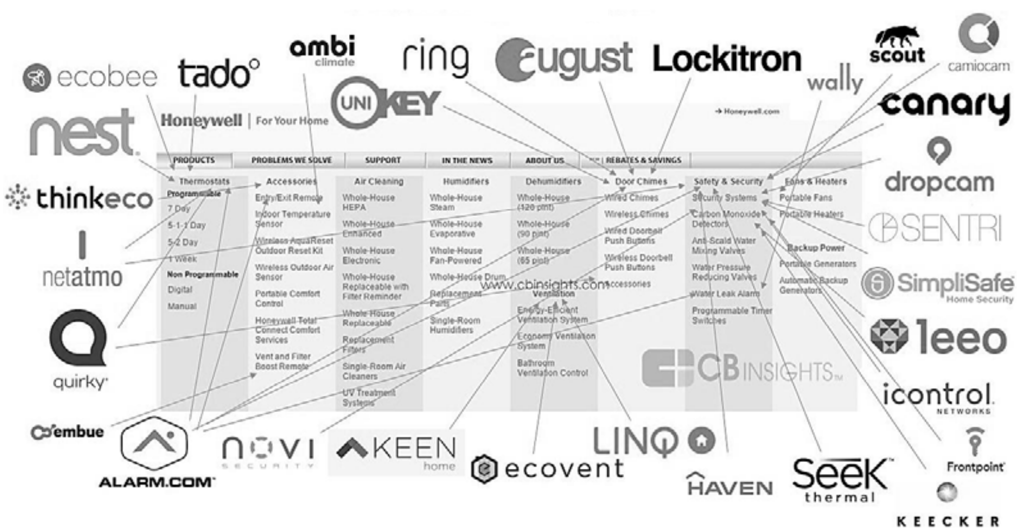
Pursuing the first implies an active, if selective, partnering strategy either via contractual relationships or more robust vehicles such as joint ventures. From the incumbent's perspective partnering in any mode exploits the dependency of the smaller partners on the incumbent's assets. The aim is to pursue either (i) a learn-and-let-go strategy – i.e. to adopt and adapt agile business models to the incumbents business as taught by the smaller, innovative partners and, eventually, beat them in their own game – or (ii) an acquisition strategy that advocates integrating promising growth companies as new lines of business via acquisitions.

The second avenue requires paradigm shift -level changes in corporate strategy and leans heavily on the capabilities the digital revolution is promising to provide: The platform strategy advocates incumbents to tactically surrender entire lines of business to up-and-coming growth companies that have the competitive edge in the afore mentioned niche businesses. Then, incumbents leverage their highly coveted assets to become platforms for growth companies, providing them with standardized development toolkits, access to the consumer interface, payment interface, transactional back-office functionality and other key resources to develop, launch and run their businesses. In Smart Mobility, one of the key roles of platform providers will be the seamless integration of the various services developed by independent growth companies that populate the platforms. After all, seamless integration of multi-modal private and public transportation is what defines Smart Mobility.

One of the key roles of platform providers will be the seamless integration of the various services developed by independent growth companies

The first question that comes to mind when thinking about the platform business model is how to monetize it. An early and established example of a successful platform business model is that of Apple's App-

Figure 8.2
Unbundling Honeywell



Source: www.cbinsights.com

Store. Apple simply takes a cut of every transaction concluded on its AppStore platform; a whopping 30% to be exact. The platform strategy is attractive because it provides benefits to both incumbents and growth companies alike: Startups and SMEs gain access to the ecosystem-specific assets such as capital-intensive infrastructure and market channels without having to make excessive investments. Incumbents, in turn, can profit from the scalable and fast-growing businesses of growth companies by taking a cut – basically a service fee for running the platform – without having to adopt new business models that do not necessarily fit their organizational or capital structures.

Establishment of standards for system interconnectivity high priority for economic developers

Economic developers can help in clearing the playing field from obstacles. Smart Mobility, even more so than Smart Grid, is all about real-time coordination of mobility assets, infrastructure and human beings that currently are using a multitude of systems and related standards that do not communicate across system borders. Standardization here is all the more important than in Smart Grid because adding the masses of consumers, their mobile devices and vehicles as well as the mind-boggling amount of transactions they initiate between involved systems makes integration and coordination a lot more complex[1]. Interconnectivity of systems is therefore paramount for scaling the Smart Mobility ecosystem. Large incumbent companies intent on building platforms for Smart Mobility can do only so much in dynamic economies. The emergence of too many competing standards can be a real drag on the evolution and growth of Smart Mobility as a promising ecosystem. Economic developers could promote such growth by aggressively pushing for universal standards in inter-system connectivity via legislative measures.

Interconnectivity of systems is paramount for scaling the Smart Mobility ecosystem

Takeaways for economic developers

Three distinct ecosystems, tens of industrial sectors, hundreds of companies, one summary; what have we learned about Cleantech and its future from the Nordic perspective? Let us conclude the book with a few words directed at economic developers, one of the key stakeholders to MARFS.

Our analyses have clearly shown that for business and economic development purposes the only feasible approach to Cleantech is to deal with it by the ecosystem. The three ecosystems analyzed in this book – Smart Grid, Smart Mobility and Green Chemistry – all feature different industrial structures, make vastly different value propositions, address different markets and involve a very different set of stakeholders. There is little value in cursorily lumping them together under a quasi-common concept such as Cleantech or the Bioeconomy. These concepts have no substance as they do not refer to specific industrial or economic activity.

Hence, it is also very challenging to develop concrete instruments for economic or business development purposes that are to promote such activity. At worst, scarce resources are put to suboptimal use, as they are allocated over a vast spread of individual companies and projects that might be a fit with the overall theme of Cleantech but have no common denominator in the form of an industrial ecosystem and its underlying value chains. Our results on the Bioeconomy provide for an excellent showcase.

Economic developers need to better align development instruments with identified industrial momentum – based on an in-depth understanding of the businesses and industries involved in any given emergent ecosystem – to avoid overly long and costly strategies with little economic impact in the short- to medium term. Instead of pumping resources into policy-driven excitement, our results call for a focused approach, supporting existing – if incipient – industrial drive with ecosystem-specific instruments.

Smart Mobility and Smart Grids are in the throes of growing pains

Our results show that even the more promising ecosystems such as Smart Mobility and Smart Grids are in the throes of growing pains. There is much that economic developers can do efficiently to alleviate them. The poor leveragability of industry assets and connections for market access across the board speak of fragile, budding industry structures that make it difficult for companies to establish robust markets and steady businesses in the short term. Companies of different sizes suffer the symptoms in their own ways. On the one hand, large incumbents do wield the assets necessary to conquer the ecosystem – telecommunications operators seem to have an especially favorable vantage point in smart ecosystems – but shoot themselves in the foot by applying conventional, capital-intensive business models that leave the door open for more agile growth companies that harness the potential of digitalization to exploit opportunities. On the other, startups and SMEs indeed show the drive and lean on nimble enough business models but utterly lack the assets for a full-scale conquest.

It is easy to envision a symbiotic relationship, in which incumbents provide the capital-intensive assets while their smaller peers introduce the competitive business models. Given the incipient structure of the ecosystems, however, just finding appropriate partners can incur considerable transaction costs. Here economic developers can step in, helping to find matches via collaborative accelerators that broker partnerships between industrial heavy-hitters on a mission of industrial renewal and small growth companies looking for resources and downstream assets.

Finding partners is a formidable challenge in and by itself, but our conclusions point to even more systemic impediments to industrial renewal that lie outside the industry's sphere of influence. One such is the lack of proper standards for the interconnectivity and interoperability of the various, often proprietary, IT systems that the numerous stakeholders to ecosystems run their businesses on. Especially smart ecosystems – by definition – build on the seamless interoperability across diverse system architectures and organizational boundaries. In the absence of universal standards, interconnectivity needs to be established one relationship at a time, building on contractually agreed, customized solutions that do not scale beyond the specific relationship. Economic developers can considerably speed up the construction of a digital business environment by introducing universal standards that promote the emergence of plug-and-play platforms for efficient interoperability[1].

Economic developers can considerably speed up the construction of a digital business environment by introducing universal standards

Standards are needed for data security and personal safety as well. In a world of autonomous, self-driving vehicles and applications that affect offtake and feed into electricity grids, quality and safety controls for algorithms that govern these systems will be paramount for individual and societal safety. Thus, it has been proposed that, in order to guarantee objectivity and to avoid moral hazard traps, agencies akin to those proven effective elsewhere – such as the Food and Drug Administration (DFA) governing foodstuff and medicinal substance approvals in the US – be instituted to govern the approval of algorithms that are introduced into networked systems such as those necessary to run Smart Grids and Smart Mobility environments. Early establishment of central bodies that set the boundaries of the playing field will help in promoting clarity and standardization in incipient ecosystems the growth of which suffer from a cacophony of competing and incompatible standards.

Finally, economic developers and governments can speed up the emergence of sustainable ecosystems, such as Green Chemistry, by driving the decoupling of industry sectors from petrochemicals and other environmentally harmful substances via legislation. The challenge is to introduce effective enough disincentives that are sufficiently strong to overcome the institutionalized vested interests that many industrial sectors share with those providing fossil-based raw materials. Incipient links to alternative raw material sources – such as biomass – can already be observed in relational data on industry links, but they are still very fragile and extremely dependent on fossil raw material prices. The current plunge in the price for oil is a great example of a strong deterrent to entry for sustainable alternatives.

Reference

1 Seppälä, T. & Mattila, J. (2016). Ubiquitous Network of Systems. Berkeley Roundtable on the International Economy, University of California, Berkeley. Download at https://www.etla.fi/wp-content/uploads/BRIE_Seppälä_Mattila-2016.pdf

Finnish summary

Sijoitusinnovaatioita talouden uudistumiseen

Kirjassa esittelemme uudenlaisen sijoitusinstrumentin. Instrumentti valjastaa niin institutionaalisten suursijoittajien kuin julkisten toimijoiden pääomapanoksia perinteisten teollisuusalojen uudistamiseen ja uusien teollisten ekosysteemien kasvun edistämiseen markkinaehtoisella tavalla. Yhdistelemällä neljä erilaista pääomaluokkaa – lainoja, riskipääomaa, velkakirjoja, ja osakkeita – yksittäisissä, temaattisissa portfolioissa saadaan rahoitus kohdennettua tehokkaasti niin pienten kuin suurten yritysten eriäviin rahoitustarpeisiin.

Yhteistyössä varainhallintayhtiöiden, institutionaalisten sijoittajien, julkisten kehitysorganisaatioiden ja muiden hyödyntäjien kanssa olemme kehittäneet prosessin, jolla (i) tunnistetaan uusia, kasvavia teollisuusekosysteemejä ja niissä toimivia yhtiöitä, (ii) arvioidaan yhtiöiden sijoitettavuus, (iii) suunnitellaan rakenne ja sijoitushypoteesi monipääomaluokkaisille, temaattisille portfoliolle (Multi-Asset Renewal Fund), ja (iv) arvioidaan portfolion riski- ja tuottoasteet sen markkinalähtöisen käyttöönoton edistämiseksi.

Testiympäristönä kehitystyölle on hyödynnetty kolmea eri ekosysteemiä suomalaisen Cleantechin ympäristössä. Näihin kuuluvat älykkäät verkot, älykäs liikenne ja vihreä kemia. Sijoitusinstrumentin ja sen käyttöönoton lisäksi kirjassa tarjotaan myös strategisia johtopäätöksiä suomalaisen Cleantechin kilpailukyvyn parantamiseksi.

FINANCIAL TECHNOLOGY
for
INDUSTRIAL RENEWAL

The world is at a turning point in many ways, there is no question. Successful best practices and business models of the last two decades suddenly hemorrhage relevance.

As the effects of digital change, demographic forces, political momentum and ecological concerns are rewriting the rules of global economic competition and sustainability, investors, businesses, and governments are on the lookout for scalable strategies and tools to harness existing and emerging resources for industrial renewal of national and regional economies.

With this book, we want to enable financiers, companies and economic developers achieve this goal. In collaboration with global practitioners in banking, investing and economic development, we have developed and road-tested an integrated set of analytical tools to design Multi-Asset Renewal Funds (MARF) – a financial technology innovation – for the promotion of renewal in one thematic industrial ecosystem at a time.

MARFs leverage capital commitments of both large institutional investors and economic developers to fuel the renewal of legacy industries and invest in the growth of emerging industrial ecosystems. By pooling both liquid and illiquid financial asset classes – such as leveraged debt, growth equity, ETFs and corporate or infrastructure bonds – in thematic multi-asset portfolios, this instrument enables systemic economic development at enhanced market returns.

Allowing for extreme customization, the investment vehicle has great potential to address the distinct financial needs of institutional investors, startups, SMEs and enterprises alike.

ISBN 978-951-628-669-6

9 789516 286696