

Capability Roadmapping – developing the means to an end

What capabilities does your company need for the future?

Rick Eagar, Daniel Roos, Michaël Kolk

Roadmapping is all about defining a clear path towards meeting a set of future objectives or ambitions. ‘Technology roadmapping’ is probably the most widely-used application of the concept. This helps companies, R&D organizations and governments to develop a clear view of future technology needs, and to articulate the necessary research and technology development steps to meet them. When used well, technology roadmaps are powerful tools to help align research and technology development activities with business aims, and they are often at the core of a well-articulated technology strategy. However, they do have some limitations – usually they are based on a set of sometimes heroic assumptions about the future, often stretching forward as much as 20-30 years. Also, they tend to focus on “what” needs to be done rather than “how” to do it: for example, they usually say little about whether a technology development will be conducted in-house, through collaboration or outsourced.

Capability Roadmaps, in contrast to technology roadmaps, focus on defining what underlying capabilities need to be developed to meet the needs of the future business, and how they might be developed. In a business environment where organizations need to be ever more responsive and agile to rapid changes and disruptions (refer also to “The Creativity Era – A new paradigm for business” earlier in this Prism), Capability Roadmaps are increasingly being used either instead of, or as a complement to, technology roadmaps. In this article we explore the benefits of Capability Roadmapping, provide some examples of their use at company and industry levels, and set out some lessons on how to get the most out of them.

Technology roadmaps can be a powerful tool to align research and technology development activities with business aims. However, they are not so helpful when it comes to defining exactly how the company can get there. This article takes the concept of roadmapping one step further, looking at the concept of Capability Roadmapping, and how it helps define and develop the capabilities a company needs to achieve its goals. The authors explore the benefits, provide examples and show how to get the best out of Capability Roadmapping.

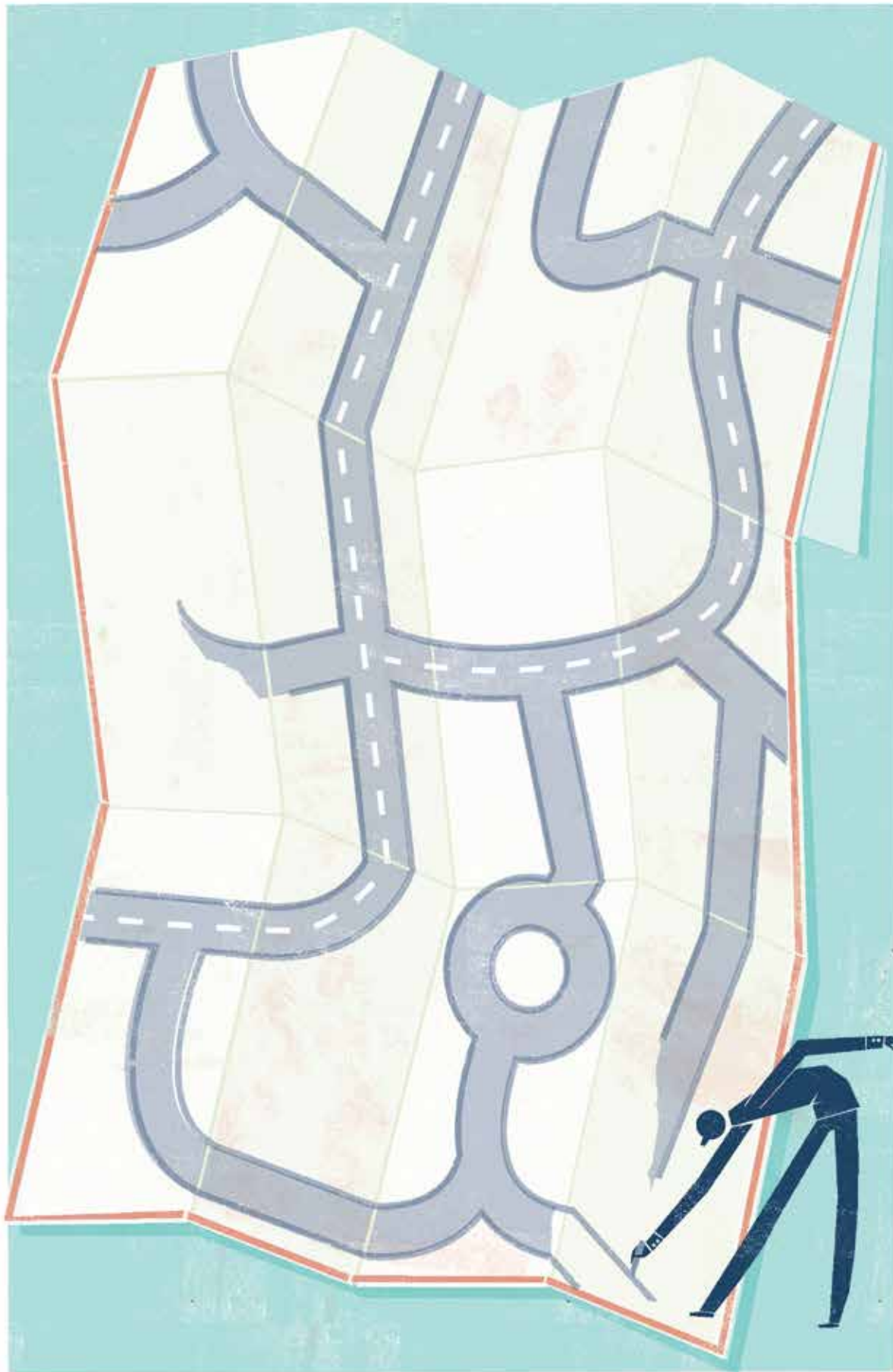


Illustration by Sylvia Neuner

The benefits of roadmapping

Roadmapping is nothing new. In the technology management world, organizations have been using roadmaps for two decades to help ensure that research and technology development is fully aligned with future market trends and product needs. Technology roadmapping on a broader scale at the level of an industry sector, sub-sector or cluster has become increasingly prevalent over the last 5 to 10 years, driven by factors such as: the increasing need for concerted effort to maintain global competitiveness, the pressure to prioritize public spending as budgets are squeezed, and the prevalence of collaborative or open innovation approaches, which have made companies more comfortable in sharing intelligence with their peers for mutual advantage.

A good example of a technology roadmap used at a national sector level is the Low CO₂ Automotive Technology Roadmap developed in 2010 by the UK automotive sector (see Table 1). This was at the core of a successful industrial growth strategy which has seen a strong recovery from recession and £6 billion of investment from global manufacturers in the last two years.

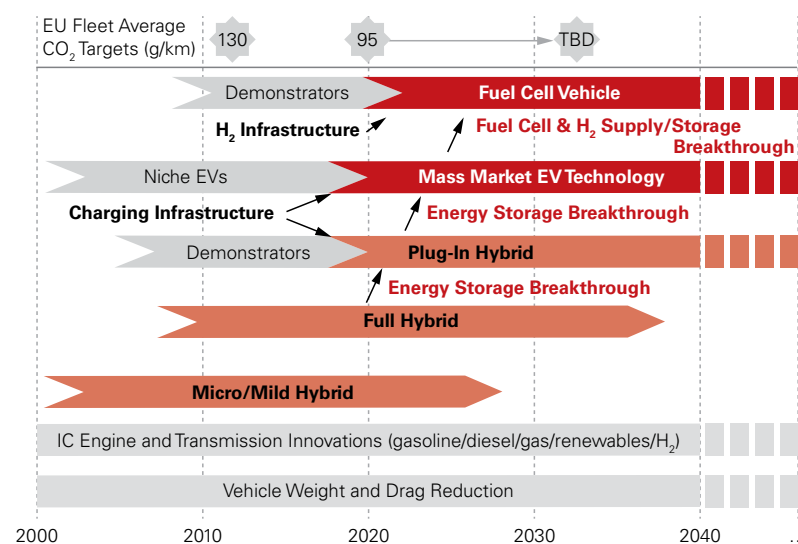


Table1
UK Low CO₂ Auto-
motive Technology
Roadmap
Source: Arthur D. Little
analysis

Technology roadmapping across a large company or sector can provide some significant benefits:

- **Engagement:** Helps to engage all key players and align them in pursuit of a shared vision.
- **Direction:** Provides a clear description of technology development directions and routes.
- **Alignment:** Shows exactly how technology development aligns with future market aims by articulating the links between technology developments and how these contribute to desired new product/service features over time.
- **Access to funding and support:** Helps identify which technology areas might attract more funding or other forms of support.
- **Insight:** Pulls together insights from different functions and disciplines to form a higher quality analysis and overall picture for a given technology area.
- **Communication:** Helps to communicate a clear story to stakeholders about the future of a technology area.

So far, so good. At its best, roadmapping is one of the catalysts for valuable collaborative innovation and technology development which may not have otherwise happened. But, all too often, what happens after the grand unveiling of the vision and roadmaps is... very little. Back in the office on Monday morning it's "business as usual" as the everyday pressures of daily operations take over. As every manager knows, making the plans is the easy part – making it happen in practice is more difficult. And this is as true for large global corporations as it is for an industry sector or region. What might be the underlying reasons for this failure, and what approaches could be used to help ensure that these grand plans are actually delivered?

Some typical problems in technology roadmapping

For technology roadmapping at the industry sector, sub-sector or cluster level, the most common problems are:

- **Lack of realism:** Sometimes the technology futures envisaged may be over ambitious given the current levels of development and/or envisaged funding levels.
- **Lack of commercial viability:** Whilst the technologies might be technically feasible, the business model may not be viable, or there may be inadequate incentives or drivers for companies to invest.
- **Lack of development know-how:** The know-how necessary to develop the technologies envisaged may be inadequate, or else may reside in another country or another sector.
- **Lack of delivery capability:** Sometimes the capacity to manufacture and bring to market the technologies envisaged in the roadmap may be inadequate.
- **Lack of a well-structured supply chain:** In many industries and regions, the supply chain may be dysfunctional – for example there may be poor collaboration between academia and industry, weak OEMs, disparate SMEs and/or fragmented supply chain structures.

For large companies, the problems with technology roadmapping are analogous but usually more acute and short-term:

- **How to deliver the necessary capabilities:** Usually a technology roadmap will require new capabilities to be available, but will not define how this will be done (for example, will they be developed in-house, through partnering or acquisition?).

- **Lack of clarity on supporting know-how elements and/or capacity:** Delivery of the technology roadmap may require a range of important supporting non-technological know-how elements and/or capacities, such as legal, commercial, HR and general management. These are often ill-defined.
- **Lack of resilience to changes and disruptions:** Technology roadmaps are often based on specific assumptions on future market/customer trends which are increasingly difficult to make in the face of changes such as accelerating global completion, new customer mindsets and unforeseen technology disruptions. A roadmap may quickly become obsolete if it is too technology-specific.

What all this means is that technology roadmapping alone may give rise to strategic plans which are insufficiently robust to change and poorly underpinned in terms of how they will actually be delivered.

How Capability Roadmapping can help

As mentioned above, Capability Roadmapping is about defining what underlying capabilities need to be developed to meet the needs of the future, and how they might be developed (the “how” of achieving the strategic vision). It is important to be clear about the difference between Capability and Technology, as sometimes this distinction can be quite subtle and there is scope for confusion. For our purposes:

- A Technology is the specific “know-how to achieve a specific technical aim or outcome”
- A Capability is a more general “ability to perform an action to achieve something useful”, which could include elements of knowledge, experience, capacity and/or skill (e.g., ‘Design, manufacture, commission and support advanced control systems in safety-critical applications’).

Typically, Capabilities are more generic in nature than Technologies – so a particular Capability (such as ‘Design and manufacture

advanced control systems') could be relevant for a number of Technologies (such as Intelligent Traffic Management, Power Systems Optimization for railways, and, say, Driverless Cars for the automotive sector). A Capability could also be generic and cross-cutting such as "Complex program management" or "Managing external knowledge expert networks".

A Capability Roadmap often exists as a complement to a technology roadmap. Whilst the technology roadmap will define what needs to be achieved, the Capability Roadmap describes how to get there, focusing on how the capabilities will be developed rather than routes by which technological goals will be achieved.

There is no single agreed format for a Capability Roadmap, but typically it will at least comprise:

- A way of describing detailed capabilities in a practical structure or taxonomy that facilitates further analysis
- A mapping of capability strengths and weaknesses based on the taxonomy
- Illustration of how capabilities link with, and support, technology development activities and vision
- Description of practical actions or enablers required in order to develop/acquire/access the key capabilities identified.

Example for Industry Sector Capability Roadmapping

Table 2 below gives an example of a Capability Roadmap which was developed for the UK railway industry (see Box 1), which comprises three main elements - Vision, Focus Areas and Enablers:

In this example, which relates to the "Low Energy Railway," the Vision is defined in terms of milestones for capabilities that the UK railways will have developed in 5, 10 and 10+ years. At the next level down, capability development is defined in terms of particular focus areas and priorities – this part of the roadmap is closely relat-

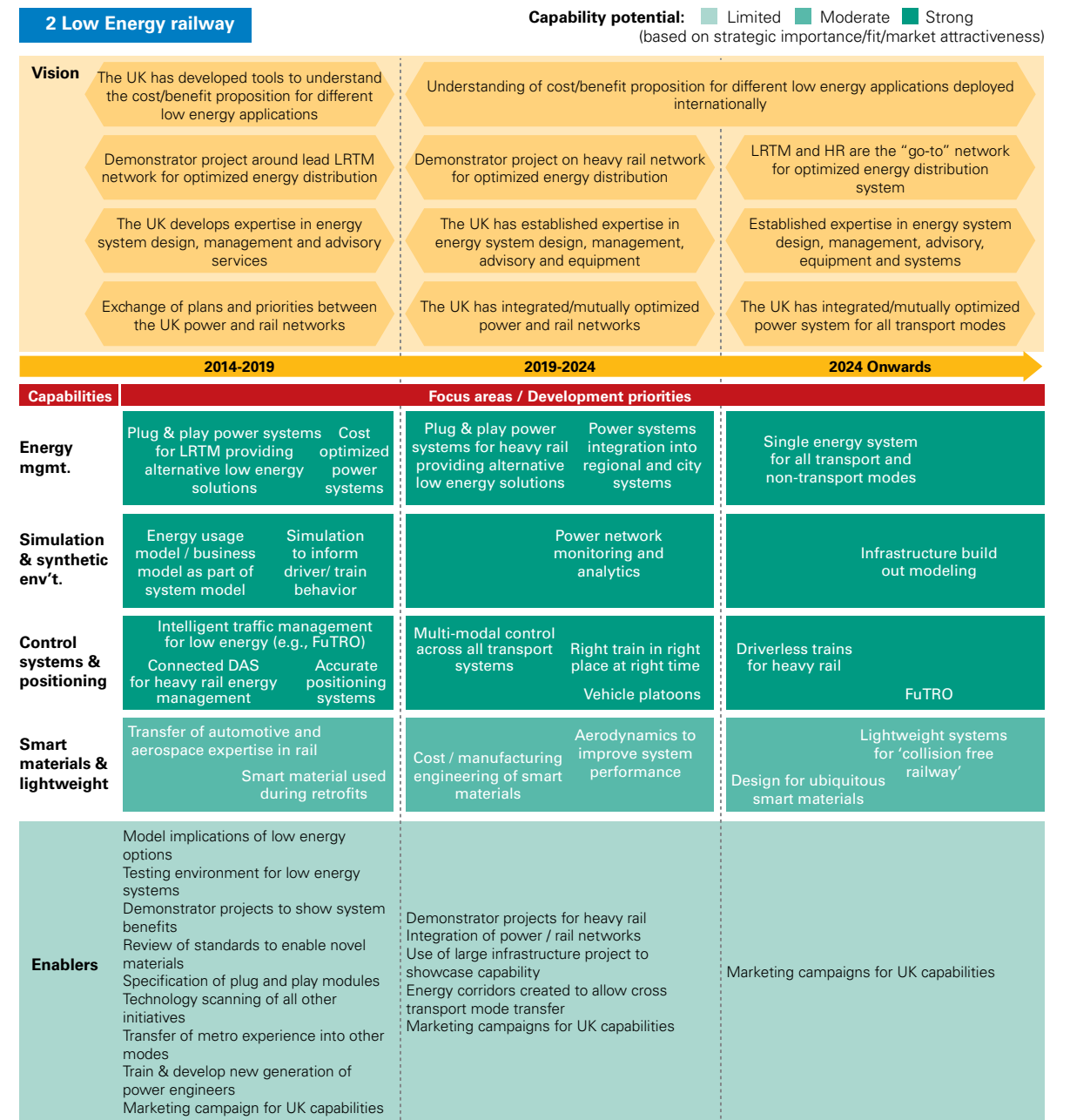


Table 2 Example of a Capability Roadmap

Source: Arthur D. Little and Atkins

ed to technology goals (which in this case were defined previously in a series of technology roadmaps), but are intentionally "technology agnostic" in terms of specific solutions. Importantly, the bottom section of the roadmap sets out the key "Enablers," which are important actions that need to be taken to enable progress to be made. Enablers can be

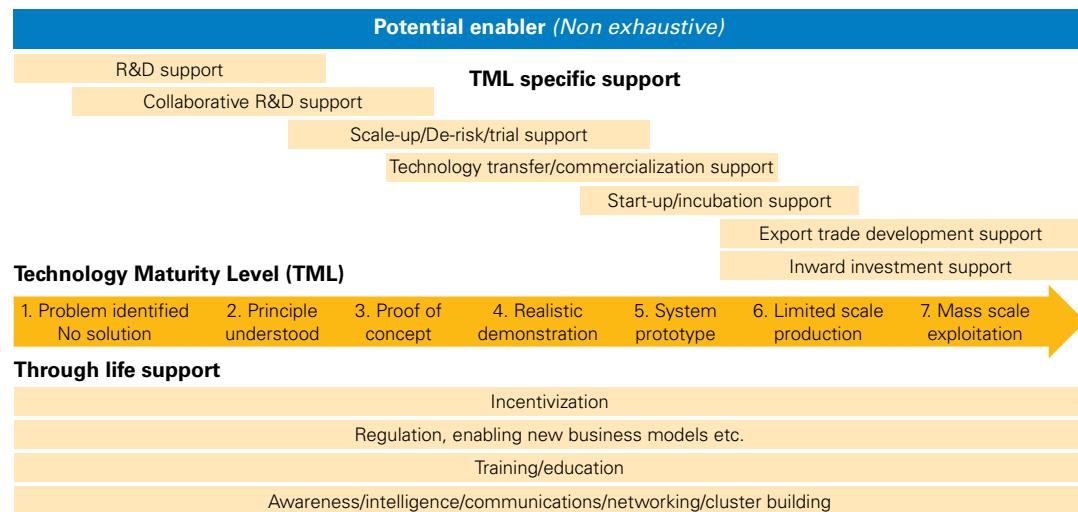


Table 3 Taxonomy of enablers for capability development

Source: Arthur D. Little

diverse, relating, for example, to standards, communications, or business model development. Table 3 above gives an overview of the sort of enablers that might be relevant for an industry sector-level capability development initiative:

Experience shows that in developing industry supply-chain capabilities, attention to enablers is essential. All too often the root causes of lack of progress in technological innovation are connected with obstacles such as:

- Lack of viable business models
- Unclear market potentials or market access
- Restrictions caused by standards and specifications
- Difficulties in bridging the gap between laboratory and full-scale demonstration
- Lack of technology transfer from other sectors, and
- Risk aversion/conservatism in accepting new technologies.

Enablers are intended to focus on overcoming these barriers.

Box 1: Capability Roadmapping for the UK's railways

The UK railways were the first in the world to privatize and today account for some £12 billion per annum of expenditure, with demand growing rapidly for both passengers and freight now and over the coming decades. Whilst the UK rail manufacturing supply chain has declined in scale in the last decade in the light of strong international competition (for example, from France and Germany), there is now a clear recognition of the need to invest in growth – in order to meet the UK's transport needs and to rebuild the international competitiveness of the supply chain and deliver economic benefit to the UK. A new Rail Technical Strategy has been recently launched with broad support across railway operators, the supply chain, government and academia, setting out ambitions for the future railway to 2030. There are also several existing initiatives within rail, transport and other sectors to help drive innovation within the UK's supply chains.

In recognition of the fact that reaching the ambitions of the Rail Technical Strategy would need concerted and aligned effort from all the key stakeholders, a separate initiative was launched to construct Capability Roadmaps for developing the capabilities needed. This included assessing the strategic importance, UK supply chain strength, and international market potential of a broad range of capabilities such as Whole Life System Optimization, Simulations & Synthetic Environments, Propulsion Systems and many more. It also included a survey of current technology development activities throughout the UK's supply chain to assess potential future as well as current strengths. Using an approach that emphasized maximum engagement with the stakeholder community, a set of five roadmaps was developed, each comprising Vision, Focus Areas and Enablers over the short, medium and longterms. These roadmaps provide an evidence-based blueprint for coordinated stakeholder action in priority areas in order to demonstrate business models and market feasibility, form alliances and collaborations in key technology areas, promote scale-up and demonstrations of prototypes, transfer technologies from other sectors such as aerospace and automotive, and go to market with more integrated solutions.

This approach is already delivering many key benefits, including identifying priority technology areas in which to invest, aligning stakeholders around a series of key measures to overcome longstanding barriers to innovation, leveraging cross-sectoral industry strengths, and improving international competitiveness.

The benefits of employing Capability Roadmapping, whether at the level of a large corporation or an industry sector, are significant.

The roadmaps:

- Provide a rational strategy and set of actions for ensuring that capabilities are adequate to meet overall technological ambitions and goals.
- Ensure that gaps in capability are clearly identified, and suitable measures are put in place to address them – for example, by partnering, training or acquisition.
- Help to engage different stakeholders, for example, Tier 1-3 suppliers, R&D providers, customers and support agencies, in a common development strategy.
- Help to communicate to all stakeholders not only the “grand ambitions” but also the practical measures needed to achieve them.
- Provide a clear and transparent link between technology strategy and industrial development strategy.

Example for Company Capability Roadmapping

Capability Roadmapping is being increasingly used within large companies as an adjunct to technology roadmapping, especially by those companies which have:

- Extensive global R&D operations, often built up through acquisition
- Technologically complex products/services underpinned by innovation or technology platforms
- A well-established open innovation system with extensive external networks
- Mature businesses facing threats from new competition, and who need to identify new or adjacent business opportunities

- Strong pressures on increasing efficiency and productivity in development work
- Critical skills and capabilities which could be lost through retirement.

Arthur D. Little has been recently working with large manufacturing and chemicals companies in this area. Box 2 below provides an illustrative example for a power generation equipment company.

Box 2: Capability Roadmapping for PowerCo

PowerCo is a global manufacturer of power generation equipment with a long-standing tradition of developing and manufacturing high performance products, sold in all corners of the world. After having recently consolidated its development activities into three main sites, PowerCo wanted to drive increased commonality and productivity across the sites through harmonization, which included identifying shared technology programs and defining the most appropriate work split between in-house and supplier development. This was achieved by first mapping the complete technology landscape and identifying the most promising technologies that would form the basis for shared technology development.

Systems	Related capabilities	Benefit from standardization	Strategic impact of capability	Competitive position of capability	Design level	Control level
Generator	Transform energy into electricity by using a two-pole generator	High			Detailed design	No change allowed (sub-supplier controlled)
Cooling system	Cool generator using sea water	Medium			Function spec	Deviation allowed within agreed function boundaries
Vibration measuring	Measure vibration using shaft sensors	Low			Function spec	Deviation allowed within agreed function boundaries

To what level of detail do we specify/design the system before handing over responsibility to a supplier?
 How firmly do we control/allow changes/deviations from the agreed detailed design drawings supplier?

The next important step was to assess the capabilities needed to deliver on these technology programs as well as the current project portfolio and product plan in terms of their strategic impact. For example, design for serviceability was assessed to be of high

strategic importance given that approximately 50% of revenues and an even greater percentage of profit stemmed from aftermarket services. This area was identified and roadmapped for further development into a core competence through closer collaboration with the service function and R&D. Conversely, other areas were identified as being of lower strategic importance, for which PowerCo could focus on system understanding rather than on detailed function or component knowledge.

Despite being in a mature industry where products have undergone multiple standardization initiatives, the first quick assessment identified significant productivity and product cost saving gains.

Lessons for policy makers and company executives

In using Capability Roadmapping techniques effectively there are some key lessons to be learned:

Lesson 1: Understand where your capability gaps are in delivering your strategy

All too often organizations spend a great deal of effort in defining strategy and ambitions (the “what”), and then neglect developing the capabilities needed to get there (the “how”). Capability Roadmapping helps to ensure that your strategy will be delivered by design, starting with your current strengths and weaknesses. In a world where a single closely-defined technology strategy may be too rigid and vulnerable to global competitive threats, defining current and future capability needs can be very valuable in building resilience and enabling opportunities for pursuing new business areas in addition to the core market.

Lesson 2: Address business model obstacles and incentives

One of the most common reasons why innovations do not progress as policy makers or executives would wish is that the business models or incentives around their development and adoption are not viable. In developing capabilities for industries in regulated

sectors such as transport, energy or telecoms, attention has to be given to establishing viable business models at an early stage – for example, through regulation, standards or partnerships. Similarly, for large corporations, executives need to ensure that systemic barriers hindering innovation between different geographies, functions or external partners are clearly identified, and that measures to overcome them are included in development plans.

Lesson 3: Build in mechanisms to develop the supply chain

Often there are inherent weaknesses in parts of the supply chain, for example, in terms of the capabilities of certain tiers, or in terms of fragmentation. The Capability Roadmapping approach will help identify these weaknesses. For policy makers it is important to address these, for example, by developing collaborations between suppliers to achieve greater critical mass, or by creating “commercial wrappers” to enable suppliers to go to market with more coherent client solutions. For large corporations, many of which are highly dependent on outsourced or franchised operations where direct command and control may not be suitable, implementing measures to help the supply chain strengthen itself are just as important. Capability Roadmapping is an excellent way to align the supply chain in coordinated improvements. Similarly, Capability Roadmapping is a great help in shaping complex open innovation partner networks.

Lesson 4: Keep the roadmap live and continue to engage stakeholders

As with many initiatives involving different parties, the process by which the roadmap is developed is as important as the roadmap itself. Engagement is critically important to achieve aligned actions. A key success factor for Capability Roadmapping is to develop and maintain an engaged stakeholder community on a continuous basis, including periodically revisiting and updating the roadmap as progress is made and new situations and opportunities arise. The stakeholders involved must also be powerful enough to take meaningful leadership action.



Illustration by Sylvia Neuner

In conclusion

For policy makers looking to develop industries or sub-sectors, as well as for leaders of large, complex corporations looking to deliver a long-term strategy in an increasingly uncertain future market, Capability Roadmapping is an effective tool to ensure sustainable business success and resilience to change. In today's world of ever more decentralized and complex global partner networks, having a clear plan of what capabilities are needed and how they will be developed over time has become critically important. Leading companies are increasingly focusing on Capability Roadmapping as they face up to these challenges.

It may not always be the case that the end justifies the means – but it is usually the case that the end may not be achieved at all unless the means are properly planned.

Rick Eagar

Is a Partner in the London office of Arthur D. Little and a member of the Technology & Innovation Management Practice.

Daniel Roos

Is a Principal in the Gothenburg office of Arthur D. Little and a member of the Technology & Innovation Management Practice.

Michael Kolk

Is a Partner in Arthur D. Little's Amsterdam office and a member of the Technology & Innovation Management Practice.

(We also acknowledge the valuable contributions of Charles Boulton.)