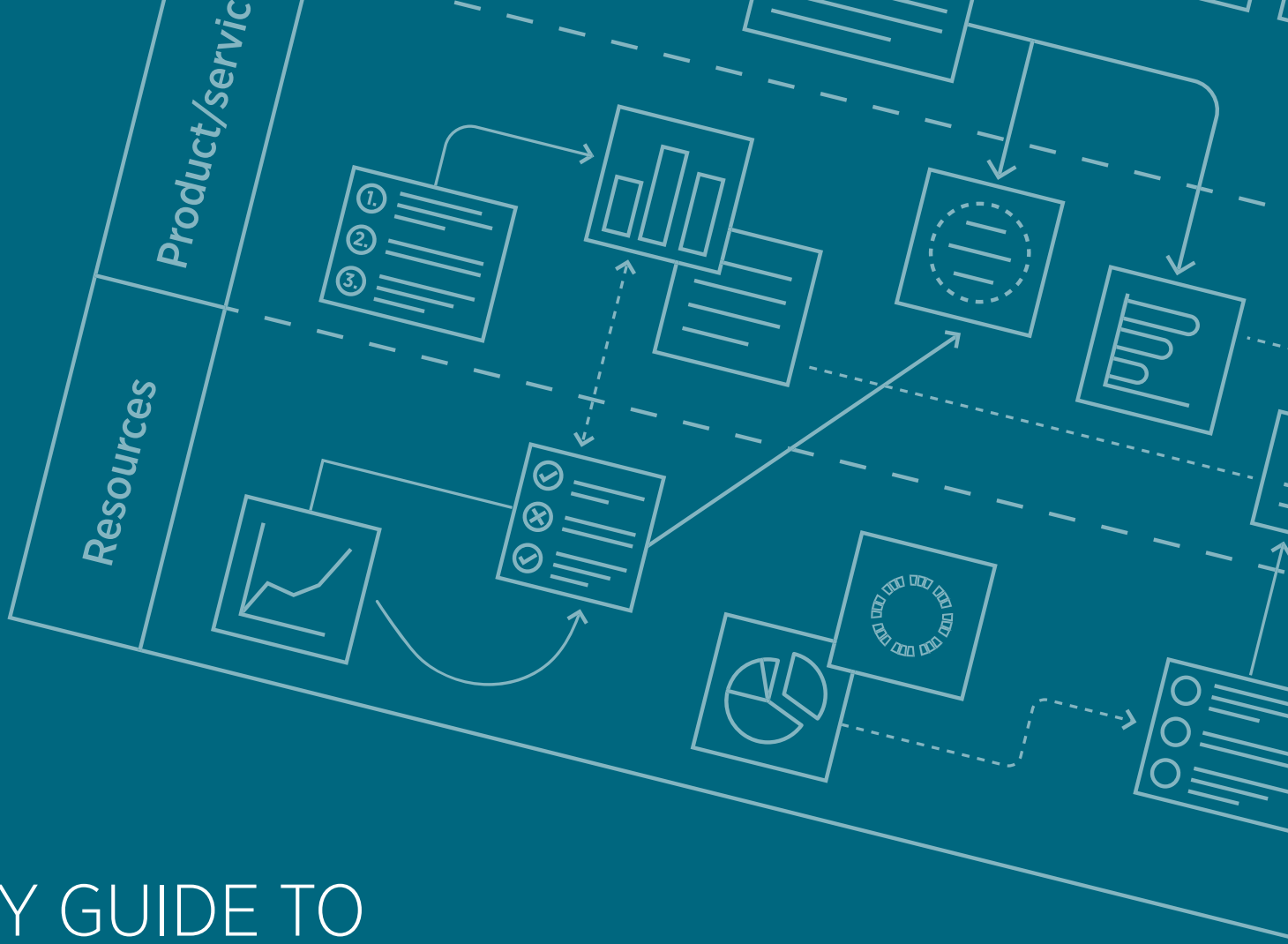

AN INTRODUCTORY GUIDE TO
STRATEGIC AND TECHNOLOGY ROADMAPS

UNIVERSITY OF CAMBRIDGE
Department of Engineering

IfM Engage

We are delighted to offer this introductory guide to roadmaps and roadmapping, so that organisations can benefit from this powerful strategic sense-making tool. It's a shame that roadmapping is seldom taught in business schools as it has been established practice in technology-intensive manufacturing sectors for more than 50 years.

In my role at the University of Cambridge, conducting research in this area for over 20 years, I've seen the utility and impact that roadmapping has on organisations of all sizes across a variety of sectors. It's a tool that will be relevant to anyone interested in strategy and innovation management for many reasons, a number of which are highlighted in this guide.

This guide introduces both strategic and technology roadmaps, providing an overview of their strengths and potential applications. It introduces basic principles for creating a roadmap, as well as covering the power of a roadmap as a communications tool. We have also highlighted links out to case studies as well as a range of supporting resources.

I hope you find this guide useful and it inspires and supports your roadmapping endeavours.

Dr Rob Phaal

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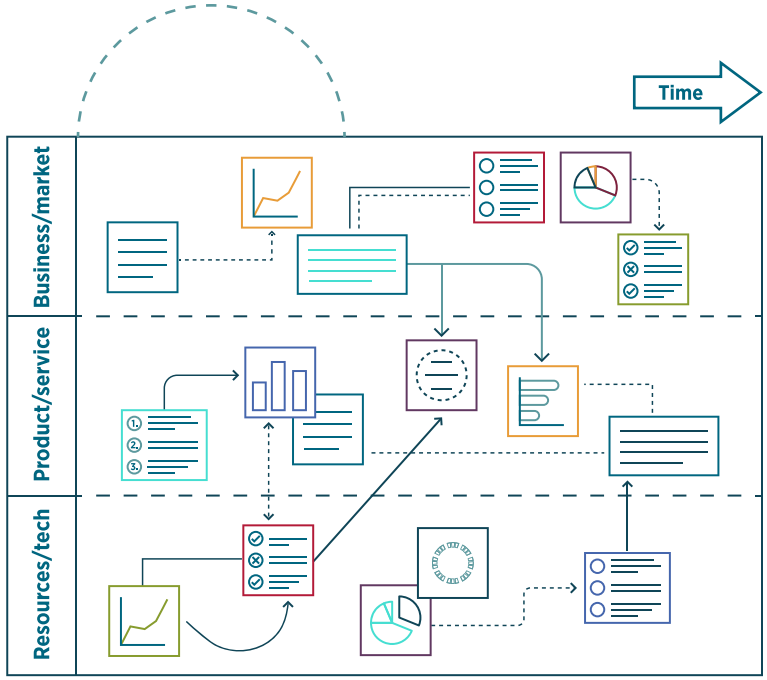
What is a strategic roadmap?

A strategic roadmap is a structured forward-looking diagram that sets out an integrated view of the way forward for an organisation, sector or other system. Roadmaps represent the pathway/s towards value, from the current position to future aspiration, along with enablers and barriers along the way.

For industrial applications, roadmaps typically combine commercial and technical perspectives, ensuring that customer needs and technical solutions are considered in tandem. A roadmap is not a static forecast, but rather a device to support strategic navigation, updated periodically as events unfold and new knowledge is gained.

Although the most common visual format looks similar to project and programme plans, roadmaps have greater scope and longer time horizon, providing context and direction for strategic decisions, plans and budgets. This format is useful for developing and deploying strategy, providing the basis for developing simpler roadmaps to support wider communication of strategy.



Why should you use a strategic roadmap?

Roadmapping is a very flexible approach and can be applied to virtually any strategic context or need, adapted appropriately. Identifying the purpose of the roadmap is vital to ensure the approach is focused and configured appropriately in terms of structure, format and process.

Organisations often consider roadmapping motivated by a need to develop strategic plans in response to opportunities or threats, yet some of the early benefits often relate to diagnostics and problem solving. Roadmaps can quickly pull together knowledge from across an organisation to establish the big picture, identifying what is known and not known to build consensus on outputs, as well as strategic decisions and actions moving forward.

There are many reasons why organisations look to develop roadmaps, but some of the most common include:

- Adapting to changes in the market, such as responding to competitive action or exploring opportunities for new disruptive technologies;
- Planning complex transformation projects in areas such as digital transformation and supply chain reconfiguration;
- Aligning multiple organisations at the start of collaborative projects focusing on resources, objectives and strategy;
- Capturing a comprehensive and clear overview of technology, market and competitor intelligence;
- Aligning technology and product direction, so organisations have the right capabilities in place to effectively capture value; and
- Enhancing an organisation's innovation pipeline by effectively linking customer needs with new product and service development.

What challenges can you create a strategic roadmap for?

The six fundamental questions associated with the roadmap structure (why, what, how, when, who and where) are universal. That's why roadmapping is an extremely flexible technique, and the systems thinking behind the method can be applied to any system. This always involves some experimentation and customisation of roadmap structure, format and process.

An internet search for roadmaps in virtually any sector, application or technology will demonstrate this flexibility, and this is supported by examination of the associated literature. Applications ranging from personal career roadmaps to co-ordination of entire sectors (such as semiconductors) have been observed.

What elements of the roadmapping process contribute to creating a successful strategy/plan?

Sometimes there is confusion as to where the boundaries between roadmapping and strategy are, as roadmaps provide visual expression of strategies and plans. It is sensible to think of roadmapping as primarily a service to other core business processes, such as strategy and innovation. Thus, roadmapping focuses on the appropriate structured visual representation of strategy, so that it can be explored, adjusted and effectively communicated.

When considered in this way, the key question becomes: what does a successful strategy/plan look like? The answer to this question will help to specify and design how roadmapping and roadmaps can appropriately support the strategic plan, and what features and attributes are required to be incorporated.

A Senior Technology Manager once described roadmaps as 'dirty mirrors' to me.

I love this analogy, as firstly it highlights that roadmaps bring to light imperfections in an organisation's current thinking about its strategy.

Secondly, once you see something, (which can often be hidden), it can be very difficult to unsee it and that can be a very powerful initial driver for change.

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What is a technology roadmap?

Generally, the term that precedes ‘roadmap’ implies the focus for the application. So, a ‘technology’ roadmap indicates that the focus of attention is technology, with more attention and space allocated to this area. However, this does not mean that the focus is on technology alone, but rather the role of technology within the broader system. This includes the benefits sought from the technology, together with development and deployment enablers and barriers.

The term ‘strategic’ roadmap is a general description that applies to most roadmaps, given the strategic focus and benefits of the method. Therefore, a technology roadmap will be strategic if facilitated correctly to answer the six key strategic questions that should be present in any roadmapping process and template. This differentiates the approach from more operational technology/ product roadmaps which have a narrower and shorter-term focus, closely aligned with project and programme plans, and process maps.

Why should you use a technology roadmap?

The main reason for developing technology roadmaps is to align the outputs of technology development with the strategic needs of the organisation or sector, in terms of desired product, service and system functionality and performance.

The visual nature and systems-orientation of roadmapping helps to address the complex and interdependent nature of technology development. Roadmaps support communication within technical teams, with commercial functions, and with external customers, suppliers, and other partners such as university research groups.

Roadmapping originally emerged in complex high-tech sectors in the USA in the 1960s, such as aerospace, energy, and semiconductors. Most roadmapping practice still focuses on technology-intensive systems, although the approach is more generally applicable and has been adopted and adapted in many other sectors over the past three decades.

Roadmap example

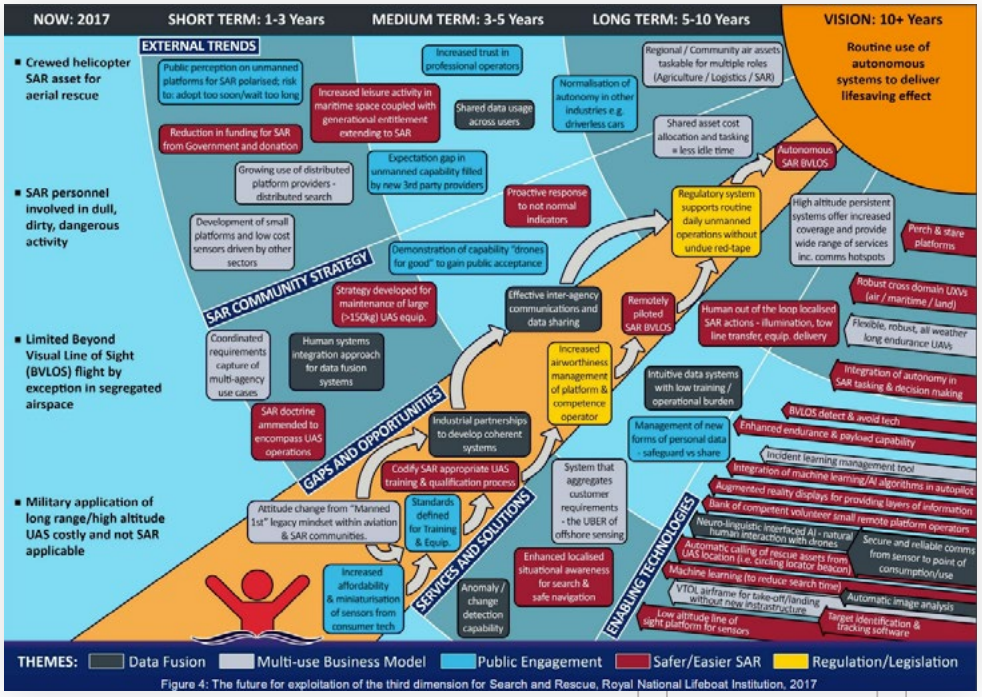


Figure 4: The future for exploitation of the third dimension for Search and Rescue, Royal National Lifeboat Institution, 2017

RNLI technology roadmap – The third dimension for search and rescue

This RNLI report summarises the outputs from a roadmapping workshop on the exploitation of unmanned air systems for search and rescue. Through the workshop and resulting report, the RNLI explored and outlined a short-, medium- and long-term plan to utilise unmanned air systems to enhance search capability, improve situational awareness, monitor areas of high risk and deliver survival aids/equipment.

View roadmap

IfM Engage worked with the RNLI to develop in-house roadmapping capability and enhance collaboration across the search and rescue field.

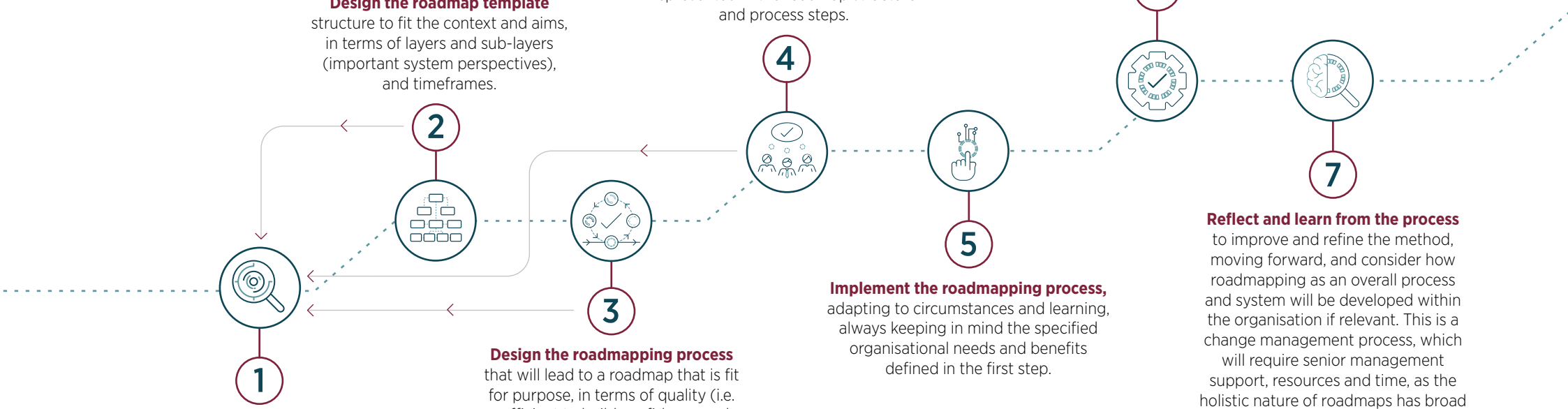
"Over 70 organisations have taken part in our roadmapping workshops, all bringing different areas of expertise and insights into how we can save more lives at sea. Our use of current and emerging technologies will be more effective if we have a comprehensive view of what's going on across the sector, helping us to collaborate with the right organisations on the right projects. Roadmapping is playing a significant part in how we are doing this."

Future Lifesaving Innovation Lead at Royal National Lifeboat Institution (RNLI)

View case study

How do you develop a roadmap?

The roadmap template (including structure and format), and associated roadmapping process always needs to be customised to match purpose and context (to a greater or lesser extent) depending on the novelty of application. **However, the following seven steps are normally involved in developing a roadmap:**



Clarify application context
in terms of the organisational processes and needs that roadmapping will address and anticipated outputs and benefits, together with any constraints (e.g. budget and duration) and assumptions that apply. It is helpful to form a small steering group to support design and management of the process, including the roadmap owner ('customer'), process facilitator and other selected stakeholders.

Design the roadmap template
structure to fit the context and aims, in terms of layers and sub-layers (important system perspectives), and timeframes.

Design the roadmapping process
that will lead to a roadmap that is fit for purpose, in terms of quality (i.e. sufficient to build confidence and consensus about decisions and actions arising). The process is likely to be divided into phases, and incorporate various elements of data collection and analysis, stakeholder consultation (e.g. interviews, surveys, workshops), and the use of other supporting tools and frameworks.

Identify key stakeholders
that should be involved, which relate largely to the layers and sub-layers represented in the roadmap structure and process steps.

Implement the roadmapping process,
adapting to circumstances and learning, always keeping in mind the specified organisational needs and benefits defined in the first step.

Validate and use the roadmap,
refining and updating it as appropriate.

Reflect and learn from the process
to improve and refine the method, moving forward, and consider how roadmapping as an overall process and system will be developed within the organisation if relevant. This is a change management process, which will require senior management support, resources and time, as the holistic nature of roadmaps has broad organisational impact.

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Who is involved in developing a roadmap?

Only a limited number of people can be directly involved in roadmap creation; but, once developed, roadmaps facilitate much wider stakeholder consultation and engagement.

When embarking on a roadmapping activity, consider the following stakeholder groups:

1. Roadmap 'owners' and 'customers' (that are responsible for the overall roadmap content, decisions and budgets, and those that the roadmap seeks to influence);
2. Process facilitators (that will be responsible for operational deployment of the roadmapping activity);
3. Key functional representatives (that have responsibility and expertise relating to the various layers and sub-layers of the roadmap structure); and
4. Other participants (that are necessary for success – e.g. customers or suppliers, external experts, operational representatives).

Improving communication

It is often said that the process of roadmapping is more valuable than the roadmap itself. The roadmap structure helps to organise conversations and capture perspectives, providing a common reference point and resource for strategy. This helps with interaction and communication, building trust and consensus, and reducing conflicts and information asymmetries in the organisation.

What is agile roadmapping?

Organisations and leadership teams are facing a rapidly changing business landscape which is complex and rife with uncertainty. In such situations, responsive and adaptable solutions are needed so that organisations can adapt quickly to threats and opportunities as they emerge. 'Agile' methods provide a pragmatic solution for dealing with uncertainty, and are increasingly being used in relation to roadmaps and roadmapping.

When considering agile methods in roadmapping, it is important to clarify how agility impacts the focus, timescales and outputs of the roadmap.

Roadmaps used in agile software development are often much more limited than methods that have emerged from hardware development, owing to the speed of software as a technology. Such roadmaps tend to focus on product release schedule and associated feature sets, and are often rather short-term in outlook, given the pace of innovation. General uncertainties associated with the longer term are not explicitly considered, as it is possible to deliver and test solutions as a means of reducing uncertainty.

Roadmapping originated in hardware development as a visual tool in the lean tradition, incorporating more sophisticated systems thinking and structure, compared to software applications. There is scope to improve agile practices with roadmapping thinking, provided the cycle time fits, allowing for the organisation to be more agile (responsive) in terms of strategy.

Top tip: Think big, act fast

IfM research has focused on developing 'fast-start' methods for roadmapping, which align well with agile thinking and methodology in terms of cycle time. This means agile methods can be used to help organisations become more responsive in terms of strategy.

Fast-start workshops are short in timespan (usually 1–2 days) and are ideal for organisations looking to begin roadmapping initiatives as they involve relatively low resource and time commitments. The process is undertaken in a rapid prototyping way, so the organisation learns from and starts to tailor the approach to their needs whilst improving the likelihood of 'quick wins'.

What makes a roadmap successful?

The future is inherently uncertain, so the success of a roadmap should not be judged based on how accurate it is as a forecast. Some of the most successful organisations that utilise roadmapping understand this and regularly review and update their roadmaps as events unfold and knowledge is gained.

Rather, success should be judged according to the service that roadmapping provides to the business in terms of confidence and consensus around decisions and actions arising from each iteration.

Factors that directly impact on success include:

- Clarity of purpose in terms of what benefits are sought from roadmapping;
- Designing roadmap structure and format to fit purpose and context;
- Designing and implementing an effective and efficient process to gather, analyse and synthesise relevant information;
- Involvement and consultation with relevant stakeholder groups; and
- Process reflection and learning, to continuously improve the process and outcomes.

Top tip: Avoid too much detail

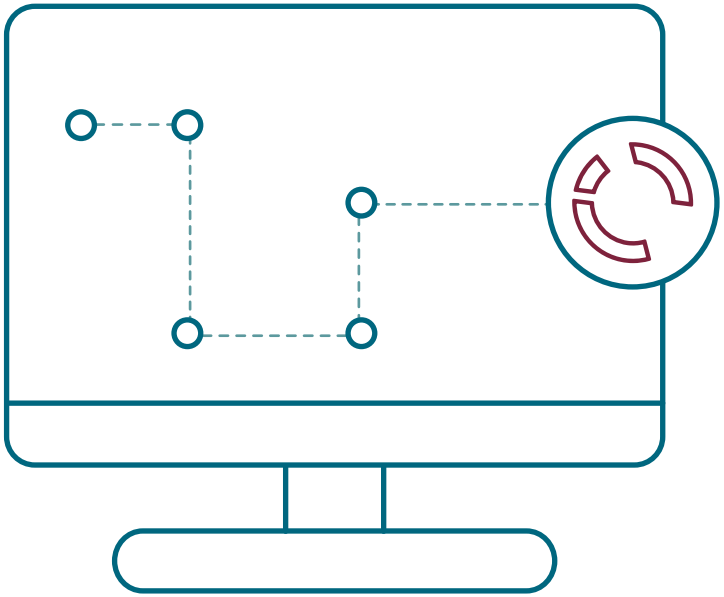
As a navigational tool, roadmaps should focus on the overall strategic level of information necessary to co-ordinate activity in the system. Burdening roadmaps with too much detail will reduce important strategic impact and increase the effort required to maintain them. Ensuring roadmaps focus on the most important strategic issues, and that roadmapping processes are as light and agile as possible, maximises benefits and minimises costs.

What role does software play in developing roadmaps?

Software can have a large impact on roadmapping efficiency and effectiveness, along with other rapidly evolving digital technologies. However, software can also lead to problems and challenges and should be deployed with some caution. Software alone will not lead to effective roadmaps (and can be expensive) as the focus on software and data can lead to the associated human process being ignored, and a proliferation of complexity that has to be managed.

The general advice is to start simple, using basic tools such as paper and ubiquitous office software tools for visualisation, reporting and analysis. This is because roadmapping must always be customised to context, and once value has been demonstrated and the process is stable, organisations are in a much better place to specify how software can support the process, and which software solution fits best.

It is possible to scale-up roadmapping without software, and successful deployments in visual management rooms have been observed, associated with lean and agile development systems.

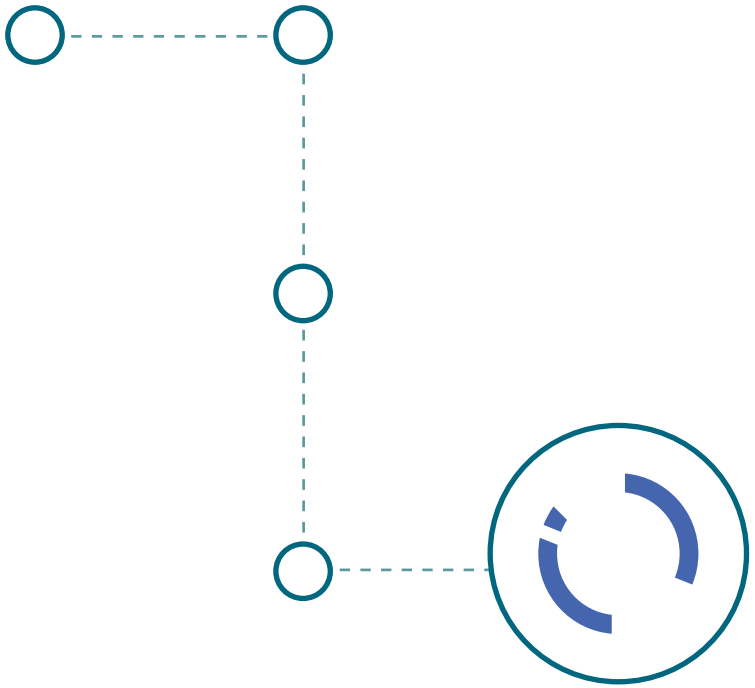


When should you refresh your roadmap?

To support strategic navigation, roadmaps should be dynamic, and need to be updated periodically as events unfold and new knowledge becomes available. Often, this refresh rate is driven by the processes that roadmapping serves, such as review points in new product and technology development processes, or annual strategy and budgeting cycles.

The required update frequency depends on the rate of change of the system. For example, software and electronics technology move quickly, compared to materials technology and infrastructure, so more frequent updates will be required. There may be other triggers for updating a roadmap, such as competitor actions, new regulations, or other disruptions to business as usual.

Updates to roadmaps may be incremental or more dramatic, depending on the nature of the changing environment. Even for incremental innovations, occasionally a ‘blank sheet’ approach is warranted, to test assumptions and to stimulate creative thinking.



How should you communicate your roadmap to stakeholders?

Roadmaps can be considered as 'pictures that tell stories', and thinking about the narrative/s that accompany the visual roadmap diagram are key to its development and dissemination. Each layer and sub-layer of the roadmap will be associated with a time-based narrative, with the interconnections between these layers defining the overall strategic narrative, in the short-, medium- and long-term.

While roadmaps should be designed to be readable in isolation, typically a supporting narrative is useful. Often roadmap diagrams are included in reports, strategy documents, proposals, and business cases, with narrative support provided in associated text.

Roadmaps are often included in presentations, which can be animated to support communication of the roadmap. Many roadmaps are published on the internet for communication and dissemination, which may include options for feedback and interaction. Software systems that support roadmapping include many features that aid communication and interaction.

Cancer Research UK – The early detection and diagnosis of cancer: A roadmap to the future

IfM Engage worked with Cancer Research UK to co-design and co-facilitate the workshop process, creating a roadmap that aims to unite fragmented efforts across the UK to drive progress in early detection and diagnosis.

"Cancer Research UK has done great work to develop a document setting out the possible future of early detection and diagnosis and a series of actions that serve as a roadmap to getting there." *1

Professor Chris Whitty

Chief Medical Officer for England and Chief Scientific Adviser for the Department of Health and Social Care

View report

*1 Quotation from p.2 Early Detection and Diagnosis of Cancer Roadmap: A Roadmap to the Future, Cancer Research UK

Roadmap examples

Public company roadmaps are extremely rare, for obvious reasons of confidentiality, although several have been published in journal papers over the years. The reverse is true for sector level roadmaps, which tend to be widely promoted and free to obtain. An internet search for roadmaps relating to virtually any sector, application or technology, will identify potentially useful roadmaps, which can be a very useful source of intelligence for company roadmapping activities and can provide inspiration in terms of graphical format.

Some caution should be exercised, though, in terms of judging the relevance, provenance and quality. The 'roadmap' metaphor is popular, and there are many 'roadmaps' available that are not representative of the method as described here. The quality of a roadmap can be fairly easily assessed, considering who created it, how it was produced, how well structured and articulated it is, and when it was developed.

Connected autonomous plant to 2035

The Connected and Autonomous Plant (CAP) roadmap will revolutionise construction safety and bring productivity gains of £200 billion if adopted by 2040. This was a collaborative project which drew on expertise from clients, academia, industry and government to create the roadmap. Stakeholders shared in the development of the vision and explored how challenges in technology, standards, legal and commercial constraints can be overcome.

View report

Roadmap examples continued

The Defence and Security Technology Competency Report

This report investigates technology landscapes to 2035 and provides different perspectives and insights into future technology and innovation models which will be relevant to the Ministry of Defence (MOD).

View report

Paediatric neurorehabilitation – finding and filling the gaps

This workshop and roadmap explores ways to improve outcomes across the patient journey, outlining ideas for future research and service-development projects in paediatric neurorehabilitation.

View report

Case studies

Fast-start to technology roadmapping for leading liquid repellent technology supplier

A leading supplier of liquid repellent nano-coating technologies used technology roadmapping to prioritise projects and support strategic planning.

View case study

One-day data measurement roadmapping workshop

IfM Engage facilitated a one-day roadmapping workshop for the National Physical Labratory, with 89 participants from 44 organisations participating.

View case study

> Roadmapping provided a valuable framework to bring the right people together to share knowledge and to transform this collaborative knowledge into delivering better strategy and innovation planning.
>
> **Manager, Technology Planning Department IHI Corporation**

Where can you get support for developing a roadmap?

IfM Engage have helped more than 300 organisations with their strategic and technology innovation planning through roadmapping.

We work with clients to blend consultancy, training and mentoring depending on project requirements to build capability and expertise.

The IfM Engage approach is built on a foundation of University of Cambridge research, so as new findings emerge, we integrate them into our toolkit to ensure our approach remains world-leading.

Training courses

View

Roadmapping consultancy

View

Online roadmapping resources

View

“The roadmap has had the biggest single impact on what we are doing in health and wellbeing and is fundamental to the progress we have made and our plans moving forward.”

Health and Wellbeing Programme Manager, RSSB

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Institute for Manufacturing (IfM)

IfM is part of the University of Cambridge's Department of Engineering. With a focus on manufacturing industries, the IfM creates, develops and deploys new insights into management, technology and policy. It strives to be the partner of choice for businesses and policymakers, as they enhance manufacturing processes, systems and supply chains to deliver sustainable economic growth through productivity and innovation.

IfM Engage Limited

IfM Engage partners with organisations across industry, government and academia to support them in solving complex challenges, using approaches and knowledge developed at the IfM. IfM Engage offerings are grounded in exceptional research, combined with a breadth of industrial expertise.

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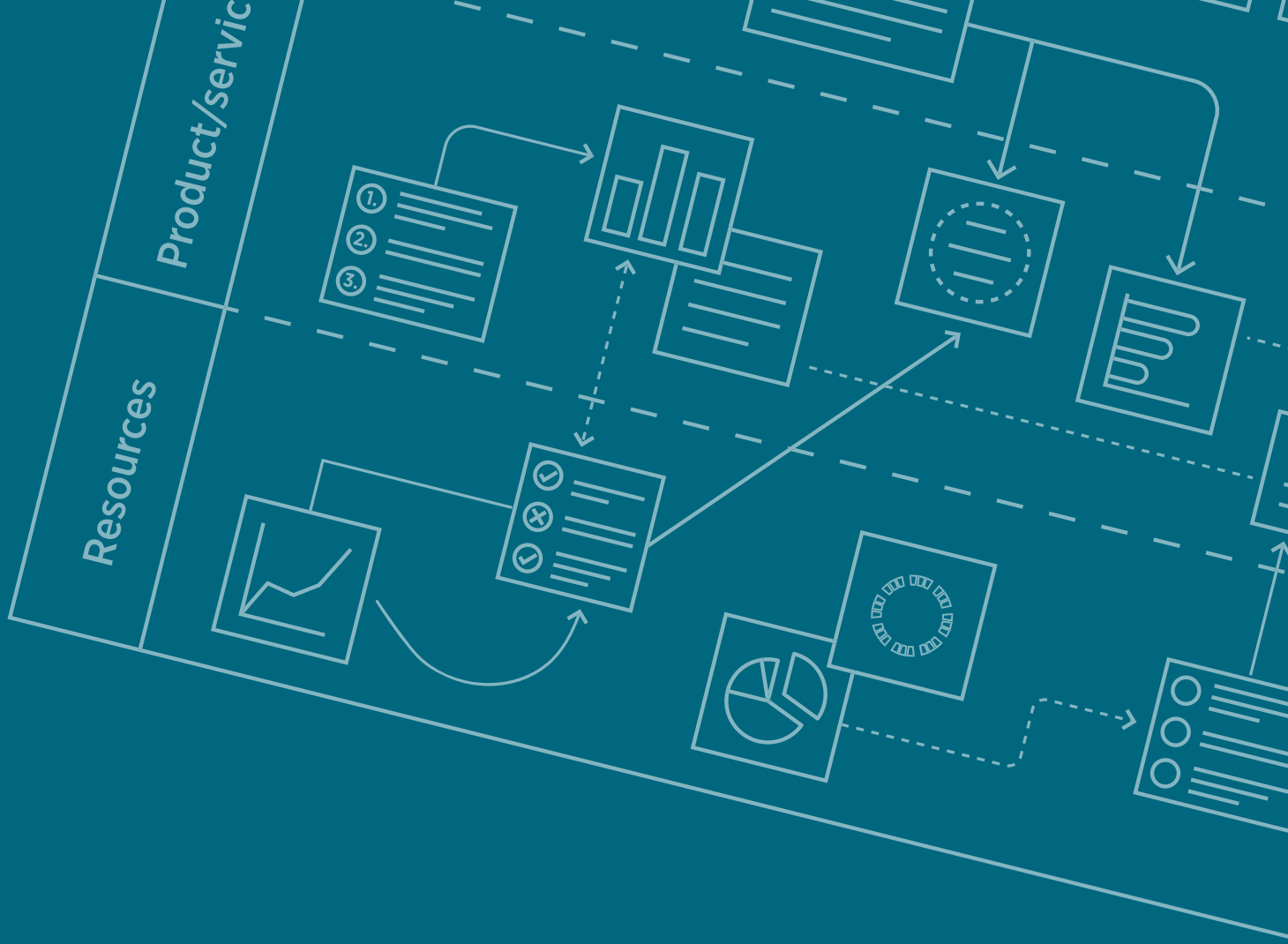

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