Expert Scan

Guidance for interview-based mapping of historical industrial emergence, evolution, development and change

S. Ford, M. Routley, R. Phaal, E. O’Sullivan and D. Probert

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1. Overview

The Expert Scan method described in this document was developed as part of the Institute for Manufacturing’s Emerging Industries Programme (EIP)\(^1\), as a deliverable from the Managing Creation and Transitions Project\(^2\). It forms part of a suite of related approaches, underpinned by a conceptual framework, with a particular focus on technology-intensive innovation:

a) *Industry Scan*: mapping and understanding historical industrial emergence, evolution, development and change.

b) *Expert Scan*: interview-based mapping of historical industrial emergence, evolution, development and change.

c) *Organisation Scan*: multifunctional workshop method for mapping organisation development and change, capturing lessons learned.

d) *Emergence Roadmap*: workshop method for mapping an emergent commercial opportunity through demonstrators and actions.

The purpose of the Expert Scan method, its context and relationships to other approaches is described below, with detailed guidance provided in subsequent sections.

1.1 Purpose

The Expert Scan is an interview-based research instrument that can be used to capture personal perspectives on the evolution and development of complex industrial systems, at industry, firm or product levels. The analysis of sets of such maps for the same industry or firm can enable the identification of patterns, enablers, barriers and other phenomena associated within such systems. These insights can be used to support decision-making, along with strategy and policy dialogue.

As an interview-based approach, the Expert Scan approach is intended for use by managers, policy makers, academics, technologists, consultants and analysts to identify issues such as:

- The processes through which industrial value is generated from scientific and technological progress.
- The mechanisms associated with the development of regional industrial clusters.
- The enablers and barriers that affect successful technological innovation in firms.

1.2 Background

The approach described in this document is based on roadmapping principles. Roadmaps are structured time-based graphical representations of strategy, illustrated in Figure 1, widely used to support strategic planning at product, firm and sector levels\(^3\). The layers in a roadmap represent key dimensions of the system being considered, enabling stakeholder perspectives to be represented in a structured way.

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\(^1\) www.ifm.eng.cam.ac.uk/imrc/eip
\(^2\) www.ifm.eng.cam.ac.uk/imrc/eip/transitions.html
The roadmapping method has been used within the Emerging Industries Programme to map historical examples of technology-intensive industrial emergence and development in a wide variety of contexts. Learning from these maps has helped to understand the underlying principles and patterns of such emergence, to improve planning for the future. Key aspects of the resulting framework for mapping industrial emergence are summarised below, together with the set of practical methods that has been developed.

1.3 Framework for industrial emergence

Key aspects of the industrial emergence framework⁴ are highlighted in Figure 2:

- **Industry lifecycle**, with an emphasis on technology-intensive industries that emerge from the science base, structured according to key phases and transitions, associated with science, technology, application and market dominated activity.
- ‘**Demonstrator chain**’, demarcating the phases and transitions of industrial emergence, providing tangible intermediate targets that can be used to focus strategy.

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The framework emphasises the early stages of technology-intensive industrial emergence, focusing on four phases and the three intermediate transitions (S-T-A-M), together with associated demonstrators:

1. **Precursor phase** (science-dominated emergence): Activities that establish the supporting scientific phenomena (and/or underpinning technology platform), extending through to the first demonstrator(s) of application potential, which stimulate industrial interest and investment in particular market-directed technology feasibility studies.

2. **Science-technology transition** (S-T): Demonstrating the feasibility of a scientific phenomenon (and/or underpinning technology) to support a new market-directed technology platform, showing the feasibility of the supporting science and technology to be integrated into an application-specific functional technology system.

3. **Embryonic phase** (technology-dominated emergence): Improving the reliability and performance of the market-directed technology to a point where it can be demonstrated in a market-specific environment.

4. **Technology–application transition** (T–A): Developing the technology and application to a point where commercial potential can be demonstrated through revenue generation.

5. **Nurture phase** (application-dominated emergence): Improving the price and performance of the application to a point where sustainable business potential can be demonstrated.


7. **Growth phase** (market-dominated emergence): Marketing, commercial and business development leading to sustainable industrial growth.

8. **Mature phase**: Refining established applications, production processes and business models.

9. **Decline / renew phase**: The industry either declines (through competitive disruption) or is sustained or renewed through the development of new science-based technologies that repeat the above phases.

The above framework is a simplified representation of the complex reality of industrial emergence, which is a product of the many decisions and actions of the actors involved, ranging from researchers to firms, government agencies and consumers. However, the framework provides structure within which the behaviour of such systems can be mapped, understood and communicated, and a basis for strategy development and decision-making.

### 1.4 Toolset

A set of four practical methods (tools) has been developed within the EIP project, building on the framework for industrial emergence. They are specifically designed for technology-intensive industrial emergence, and can also be applied in other situations with appropriate adaptation (where different patterns, phases, transitions, events and milestones may have relevance) – for example:

- Exploring the evolution of technologies, applications and markets to understand how industries develop and emerge.
- Mapping the progress of a corporate venture, to identify learning points for future such initiatives.
• Investigating the various experiences of stakeholders in a regional industrial cluster, to build up a picture of how the set of firms co-evolved.
• Capturing workshop participant perspectives on past innovation initiatives in a firm, to identify strengths and weaknesses as an input into innovation strategy.
• Strategic planning for early stage technology ventures, building consensus about the long term goals and intermediate steps and actions required to move forward.

A modular philosophy has been adopted, in the sense that the methods can be used in isolation or in various combinations, with each other and with other tools and processes. Three of the methods support mapping of the historical emergence and development of industrial systems, to identify patterns, enablers and barriers – the learning from these approaches can be a useful input to strategic planning, which is the focus for the fourth method:

a) **Industry Scan (IS):** a research method for exploring, understanding and communicating patterns, enablers and barriers associated with historical industrial emergence, supporting policy, strategy and innovation processes.

b) **Expert Scan (ES):** an interview-based method for capturing personal perspectives of historical industrial emergence, which can be combined to understand patterns, enablers and barriers, as an input to strategy, policy and innovation processes (the subject of this guide).

c) **Organisation Scan (OS):** a workshop-based method for mapping and sharing experience of historical emergence within an organisation, to understand patterns, enablers and barriers, as an input to strategy, policy and innovation processes.

d) **Emergence Roadmap (ER):** a workshop-based roadmapping approach, configured to support organisations to navigate science and technology based industrial emergence, supporting decision-making and action. Multifunctional workshops enable priority steps to be identified through focussing on a demonstrator chain to commercialisation.

The Emergence Roadmap method requires a relatively clear focus, in terms of an identified future opportunity. It can be used in conjunction with the Value Roadmap (VR) workshop-based approach for exploring, identifying and prioritising future opportunities for early-stage technology.

The relationships between these tool modules are shown in Figure 3, all of which are based on roadmapping principles, enhanced by the industrial emergence framework where appropriate. The tools are positioned against two dimensions:

1. **Time:** past (learning from previous experience) and future (strategy).
2. **Level:** focus for application, ranging from industry/sector to firm and product.

As noted above, the EIP tools can be applied separately or in combination, depending on context and purpose, with the positioning in Figure 3 indicating potentially useful interactions when used together or in combination with other tools and processes. The set of three historical mapping tools can be used separately or together, and are ‘scaleable’ in the sense that they can be applied at industry, firm and product levels, The Expert and Organisation Scan approaches provide guidance on how to engage with experts through interviews and workshops. The Industry Scan focuses on the map itself, in terms of how to gather, organise and represent information relating to the development and evolution of a complex system, with particular reference to industrial

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emergence. Learning from the historical scanning methods is a useful input into future-oriented strategic planning processes, including the Emergence Roadmap and other tools and methods such as portfolio management.

In terms of other tools, of particular note is the Value Roadmap method, which is an adaptation of the more general S-Plan roadmap approach, used for general strategic planning at firm and sector levels. The VR and ER methods are particularly suited for strategic planning for early-stage technology, providing alternatives to the ‘Strategic Landscape’ and ‘Topic Roadmap’ modules in S-Plan for this context.

The workshop-based S-Plan approach is based on a modular philosophy, enabling management tools to be combined in various ways around a core roadmapping process. The roadmapping modules operate at two levels: business and topic (option) – see #3 and 7 in Figure 4. Other tool modules that have been incorporated include: intelligence map depicting external drivers (#1), scenario matrix (#2), QFD-style linkage grids (#4), innovation matrix (#5), portfolio matrix (#6) and business case templates (#8). Figure 4 relates to business strategy and innovation applications of S-Plan, which can also be applied at the sector level.

The EIP tool modules can also be positioned within the S-Plan process framework as shown in Figure 4:

- The historical mapping methods can provide an input to roadmapping modules to improve understanding of the past and current situation, so that learning points (development patterns, enablers and barriers) can be taken into account, at both business (#3) and topic (#7) levels. For example, the three methods (ES, OS and IS) might be used together where a clear depiction of the historical emergence of a sector is desired (#3), incorporating perspectives from both expert interviews and workshop engagements. When focusing on a particular innovation opportunity (#7), incorporating a workshop module (OS) prior to the topic roadmapping activity may be desirable to ensure that learning from previous developments is identified and incorporated.

Figure 3 – Tool modules and relationships, positioned against time (past and future) and level (industry, firm and product); the Value Roadmap method (dashed circle) can be used in conjunction with the Emergence Roadmap approach if helpful, to provide focus

Figure 4 – Roadmapping framework

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The Emergence Roadmap method can replace the topic roadmap module (#7) for early-stage technology exploitation strategy development (or where more structure than provided by the topic roadmapping approach is desired). Similarly, the Value Roadmap method can replace the Strategic Landscape module (#3), providing a means for identifying and prioritising application opportunities for early-stage technologies, where there may be many potential routes to market, with substantial commercial and technical uncertainties.

Figure 4 – Positioning of EIP and other strategic management tool modules within the S-Plan strategic roadmapping workshop-based method (business and innovation strategy)
2. Expert Scan Guidance

2.1 Introduction

As stated in Section 1, the purpose of the Expert Scan method is to map personal perspectives on the historical emergence and evolution of complex industrial systems, at industry, firm or product levels.

This map is a summary of the participant’s perspective of the key events and activities that have enabled or hindered historical emergence. As a ‘quick scan’ process of 60-90 minutes, it allows the insights and experience of an individual to be captured in a visual form. Analysing sets of these maps that focus on the same organisation or industry provides the investigators with an opportunity to learn about the patterns and processes that have led to their emergence and evolution.

The tool can be used by organisations and researchers as a standalone analytical tool. Alternatively, it can be used in advance of a strategy workshop on occasions when it is difficult for workshop participants to get together or when the workshop is time limited, allowing the integration of multiple perspectives.

2.2 Interview-based mapping

While described as interview-based, the mapping tool differs from the traditional interview process and the terminology used in this guide reflects this. If we describe the interaction as being one between interviewer and interviewee, then this suggests that there is an interviewer that will conduct the interview, with a set of established questions, with the aim of extracting information from the interviewee. Instead we describe the interviewer as the facilitator and the interviewee as a participant. The mapping tool involves facilitation on the part of the interviewer, assisting the participant in revealing their expert knowledge and insight into the phenomena under investigation. During the interview the participant is not just responding to questions but is active in codifying their knowledge onto sticky notes and placing these onto the map.

The mapping tool can be conducted by a single facilitator or by two facilitators.

• In the case of a single facilitator it is necessary to use a voice recorder to capture the interview so that a summary text can be created to accompany the digitised map.
• In the case of two facilitators, one facilitator leads the interview, while the other records the participant’s narrative.

A summary of the mapping process is described on the next page.
Setting up the interview
• Identify potential participants.
• Contact the potential participants. Include the following in communications:
  • An overview of the exercise.
  • The objective of the activity.
  • An illustrative map for reference.
• Following confirmation of willingness to participate, provide the participant with a briefing note that describes the mapping exercise in greater detail (Appendix A).

At the interview
• During a short introduction:
  • Remind the participant of the approach that will be taken and the objective of the mapping exercise.
  • Provide the participant with example maps so they can visualise the intended outcome of the exercise.
  • Consult with the participant to identify the focus (the unit of analysis) and the scope (the relevant dimensions and the timeframe that the mapping exercise covers) of the exercise.
  • Set up the initial canvas to include agreed categories on the vertical axis and the timeframe on the horizontal axis.
  • Inform the participant that by the end of the exercise it is expected that they will use around 20-25 sticky notes to explain the key events and activities.
  • Explain that they are free to move these sticky notes around or to discard any that they decide are not relevant.
• During the interview:
  • The participant uses sticky notes to record the key events and activities that they consider to have shaped the emergence of the organisation or industry.
  • The facilitator engages the participant, assisting their placement of sticky notes and stimulating the production of further notes.
  • The second facilitator (if present), records the narrative so that the context in which the sticky notes are being placed is captured.
• At the end of the interview, review the map and ask the participant to:
  • Mark key enablers and barriers.
  • Draw lines between connected events and activities.
  • Explain that the map they have created will be converted into digital format and their comments summarised into a supporting narrative, with these returned to them to check that they have been recorded accurately.

After the interview
• Convert the map into digital format using Microsoft PowerPoint (or similar software).
• Summarise the participant’s comments into a supporting narrative.
• Return these to the participant to check for accuracy.
3. A step-by-step guide to creating a map

Consultation with the participant at the beginning of the interview defines the time span (horizontal axis) and set of themes (vertical axis). In this example map, sticky notes have been placed to structure the canvas: 1940-2000 has been identified as the time span and four categories of government, technology, applications and market have been determined.

The participant begins to record the key events and activities on sticky notes and places these on the map. It is worth reminding the participant that the aim is to generate 20-25 sticky notes as this saves unnecessary effort both during and after the interview. It is also helpful to record the date associated with the event or activity on the sticky note when the participant can recall it.

The participant can use different colour sticky notes for particular themes. In this map, the participant is using orange sticky notes for regular events and activities, and has started to use pink sticky notes to highlight a specific theme they consider significant (in this case, demonstrators). As more sticky notes are added it may become necessary to move the sticky notes around, both on the axes and in the map itself. The time scale does not need to remain linear but can be adjusted to fit the placement of notes.
The participant continues to place sticky notes on the map until they have identified what they consider to be the key events and activities.

If the narrative stops, the facilitator can use existing sticky notes to prompt continuation, otherwise allow the participant to freely continue their narrative.

Once the participant has finished placing notes on the map, it may be necessary to move these around. In this example map, notes from 1980-2000 have been spread out.

The facilitator can use this opportunity to investigate any particular sticky notes of significance or to explore areas of the map that remain blank.

The final step in creating the map is for the participant to identify any links between key events and activities, and to label any of these as enablers (green circle stickers) or barriers (red circle stickers).
After the interview, this map is then digitised in Microsoft PowerPoint or other appropriate software. The map and its accompanying narrative are returned to the participant to check for accuracy of data capture.

This step-by-step guide represents an idealised version of the mapping process. In reality, the participant may start at one point in time and then move rapidly backwards or forwards, placing sticky notes in a scattered pattern before any logic becomes apparent. So while the creation of maps may be much messier than those presented in this sequence, the end result will be similar and the use of sticky notes allows re-organisation as it becomes necessary.
Appendix A
Example briefing note

The following text is an example of the briefing note that should be sent to the participant prior to conducting the Expert Scan. It can be customised as is required for the subject under investigation.

The Expert Scan is intended to provide a visual representation of a person’s perspective of how a complex industrial system developed and evolved. The approach is designed to be efficient, providing a ‘quick scanning’ method that enables your personal perspective on the overall pattern of emergence to be mapped. As an interview-based activity, it will take 60-90 minutes to complete and will result in the creation of an emergence map and accompanying narrative.

During the interview

Before starting the exercise, we will identify the scope of the map, including its unit of analysis and the timeframe over which the narrative unfolds.

During the exercise we will ask you to draw on your personal experiences to provide your perspective on how the industry has emerged and evolved. We will ask you to use sticky notes to identify key events and activities in the narrative to ensure that your thoughts are accurately captured. Approximately 25 sticky notes should be sufficient to capture the complete narrative.

As the sticky notes are added to the map, some notes will be identified as enablers, barriers, triggers or milestones, with connections between these where there are causal links.

At the end of the interview we will review the map with you, ensuring that the key features have been highlighted, and draw any interlinkages that have not already been made. The outcome of the interview will be something resembling the figure above for Internet emergence.

After the interview

We will convert the sticky note map into a digital format and summarise into a narrative format. These will then be sent to you to check over to ensure that your thoughts have been accurately captured.
Appendix B
Best practice when using the Expert Scan

B.1 Use of the briefing note

To engage the participant in the exercise it is important that they understand the motivation for the activity, what the activity will entail and what its intended outputs will be. Accordingly, participants should be provided with a briefing note in advance (Appendix A).

The content of this briefing note should be reiterated at the beginning of the interview. It is also necessary to include a visual example of a previous map, so that they have a vision of what the end point of the exercise will be.

B.2 Defining focus and setting up the map

At the beginning of the interview, the scope and focus of the mapping exercise should be clearly determined in consultation with the participant. The scope determines what the participant will discuss and the timeframe over which they are capable of recall.

The architecture of the map comprises time on the horizontal axis and a set of categories on the vertical axis. It is standard to begin each interview with the three categories of technology, application and market. Some participants may think that other themes are also significant and can be added, with the existing categories retained or discarded. Following this consultation, the facilitator places their own sticky notes on the map for the time span at appropriate intervals (e.g. every 5 or 10 years) and the categories.

B.3 Gaining participation

It is an important part of the mapping process that the participant writes the sticky notes, because interpretive errors can be made if the facilitator writes them. At the start of the interview it is therefore necessary to explicitly request that the participant write the notes, encouraging them to do so in order that their comments are captured accurately. Handing them a block of sticky notes and marker pen at this point reinforces their participative role.

B.4 Organisation

The basic map provides a semi-structured canvas on which the participant’s knowledge can be positioned. An advantage of using sticky notes is that it allows for the reorganisation of material on the map. Reorganisation may be required during the interview, either because of incorrect placement in the vertical themes, the addition of new vertical categories or to ensure appropriate fit along the time axis.

- If the facilitator notices the misplacement of notes then they can support the participant by moving these notes when appropriate and keep them on track.
- While three categories – technology, application and market – are typically used as categories on the vertical axis at the outset of each interview, new categories may be added during the interview if significant themes become apparent, requiring the reorganisation of sticky notes.
- If the participant has spaced out their sticky notes too much then they may need to be repositioned. While the recommended 20-25 sticky notes should fit on a standard A1 map, if more sticky notes are being used then it is possible to extend the map onto a second sheet.
Reorganisation may also be conducted at the end of the exercise by the participant. Finally, it is also possible for any incorrect placements to be corrected by the facilitator during the post-interview digitisation of the map.

B.5 Evaluation

As a visual method, the mapping technique allows the participant and facilitator to evaluate the content as it is being generated. For the participant, it allows them to assess the range of subjects they have covered and to identify any gaps that are important to their account. For the facilitator, the map provides a starting point for further probing, following the completion of a particular chain of thought by the participant.

Evaluation is also possible at the end of the interview, providing a final opportunity for the participant to include content that they had overlooked. The facilitator must be careful at this point as there may be a temptation for the participant to fill all the blank spaces on the map. This challenge needs to be well-managed by facilitators as it removes the need for participants to prioritise and select the events and activities of most significance when telling their story.

B.6 Use of colour

The visual element of the mapping technique is very important. The use of multiple colours of sticky notes is advantageous because it allows different narrative threads to be more easily distinguished. These will depend on the subject matter covered by the participant but may include different basic technologies, market applications and geographical features. However, it is important that the participant does not become overly concerned with using the ‘right’ colour of sticky note to identify the narrative item as this can disrupt the flow of the interview.

B.7 Supplementary material

The participant may attempt to draw on supplementary material during the course of the interview. It is possible that drawing on materials that they have not created could distort the map as it fails to capture their own knowledge. If the participant asks to check a particular detail, it is suggested that the purpose of the interview is reiterated: it is not to test them on their knowledge of the sector’s history but to instead gain their perspective on its history. It is also advantageous to conduct the interview in an environment where the participant does not have access to such materials.