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Roadmapping for formulating IP Strategies

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Frank Tietze, (IIPM Lab, CTM, University of Cambridge)*
Rob Phaal (CTM, University of Cambridge), Jan Hendrik Bluemel (CSA,
University of Cambridge), Tianyi Wang

* Please contact the corresponding author for feedback:

ft263@cam.ac.uk

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Abstract

The increasing relevance of intangible assets and intellectual capital for building, maintaining and growing competitiveness is causing intellectual property (IP) to take up an expanding share of a company's resources. The direct impact of IP on the value and profit of a company means that companies need to develop strategic IP management skills. However, IP is largely poorly managed by addressing it operationally at lower hierarchy levels. There is usually a lack of understanding of IP strategies and approaches to their formulation. This problem is addressed by presenting a business-tool that first conceptualises IP strategy and provides support for the formulation of business-aligned IP strategies. Through an iterative business-tool development process, a roadmapping approach was developed, consisting of a five-step process and a corresponding template. The process starts with the identification of the strategic landscape for the alignment of the IP strategy, followed by a specific formulation of business objectives to be supported. Then relevant IP assets from the ecosystem and company are considered to identify their effective use. Operational IP strategies are then formulated for individual IP assets in accordance with the business objectives and strategic landscape. Finally, a time-dependent narrative for the IP strategy is created. The approach is realised by filling out a template in a workshop, which enables company-wide communication, visualisation and understanding of the IP strategy concept. Thus, this approach supports companies of different size and industry in formulating IP strategies to support business objectives and hence value maximisation.

Managerial relevance statement

The paper presents a business-tool that helps companies to formulate an IP strategy that enhances the value of the company through strategic alignment and conceptualisation of IP strategy. It overcomes the lack of approaches to the strategic management of IP and enables companies to take a purposeful look at the use of IP resources. The business-tool addresses relevant aspects of strategic alignment, IP resources and types, and their operational use. The tool consists of a five-step process and a corresponding template, which is filled out during workshops for IP strategy formulation. This structured approach enables companies to formulate an aligned IP strategy step by step and supports structured conversations between participating experts from different fields, who often have difficulties in doing so. The approach has been proven as suitable for smaller companies, enabling the formulation of an IP strategy without the use of too many resources. Thus, it helps companies of all sizes and industries to use their IP to support business objectives.

1 Introduction

Innovation and the associated tangible and intangible technological resources have become a necessity for companies to achieve competitive advantage [1], [2]. However, they alone are not able to enable commercial success [3]. The ability of a company to benefit from its innovations through appropriation and protection determines its performance and is essential for sustaining competitiveness [1].

However, especially in the emerging knowledge economy, intangible assets and intellectual capital play an important role for building, maintaining and growing competitiveness [4]. As a result, intellectual property (IP) is contributing to an increasing share of a company's resources [5]. The ownership of critical parts of IP therefore serves as an important strategic battlefield [6]. In recent decades, an increasingly active use of patents has been observed, accompanied by a growing relevance of IP management [6], [7]. Therefore, IP management has a direct impact on the profit,

competition and value of companies. Companies need not only legal but also strategic and operational management skills for successfully using IP to their advantage [5].

Nevertheless, it still remains common for IP to be poorly managed, eg by focusing on operational management only and individual IP rights and delegating them to lower hierarchical levels in the organisation [8], [9]. As a consequence, companies miss the opportunity to create and exploit value from their IP [9].

Tanaka [10] pointed out that this inefficiency arises from a lack of clearly defined IP strategy concepts. Eckardt [11] adds that this lack of understanding about IP strategy impedes the ability of practitioners to integrate IP strategy into corporate and business strategy, hindering the full exploitation of IP potential [8]–[10], [12], [13]. In response, some approaches have been developed to clarify the concept of IP strategy eg [9], [10], [13], and for IP alignment eg [14], [15]. Despite this, the literature in this field is limited and the existing approaches mostly focus on the operational management of IP rather than long-term strategies.

For this purpose, a roadmapping approach has been adapted, as it is a widely used management technique for structured approaches to innovation and technology strategies [16]. Although many studies on roadmapping already exist, no approach for the formulation of IP strategies has been presented yet. This research ultimately aims to increase the understanding of business-aligned IP strategy, which leverages the maximisation of value creation and value capture. The tool is also intended to guide the decision-making process for the formulation of an IP strategy.

1 Theoretical Concepts

For the development of a business tool supporting IP strategy formulation, the next section presents relevant theoretical concepts from the strategy literature followed by the introduction of IP strategy and a brief review of the very few existing approaches for supporting the formulation of IP strategies.

1.1 Strategy

The concept of strategy is complex and has a long history across different academic disciplines, extensively discussing many questions and problems [17]. From the 1960s to the mid-1990s, structured strategy practices became established in industry, becoming an established academic discipline, with many well-known strategy concepts emerging considering price setting, production volumes and costs for competitiveness [18].

The competitive concept of strategy emerging around frameworks as eg the BCG matrix was expended considerably by Porter's Five Forces and the value chain model, highlighting the differentiation strategy as an alternative to the cost leadership strategy [19]. Building on the work of Porter, the significance of gaining competitive advantage by the use of strategies was highlighted, arguing that the company is positioned in the market with its competitors while simultaneously looking into the firm [20], [21]. In the late 1990s, strategy research was focused predominately on organisational change bridging the gap between the formulation and organisational implementation of strategies see [22]–[25].

Due to its multi-disciplinarity and contextuality, the strategy concept has been defined many times with different emphases [26]. One of the common and widely applicable definitions from a business perspective is provided by Chandler [27, p.13] :

Strategy can be defined as “the determination of the basic long-term goals and objectives of an enterprise, and the adoption of courses of action and the allocation of resources necessary for the carrying out of these goals”.

Based on the definition from Chandler [27] and other views of the strategy concept, Hofer and Schendel [28, p. 26] determined five core elements of strategy, with a sixth added here based on literature review:

- (1) Goals and objectives of an organisation
- (2) Scope of the strategy

- (3) Resource deployments
- (4) Competitive advantage
- (5) Synergy
- (6) Revision

Every strategy includes *objectives*, which are formulated as intermediate-term targets to satisfy the goals a company seeks. Goals reflect missions and visions, whose statements are combined to define objectives and the organisation's approach to reach them. The *scope* of the strategy defines the extent of the organisation's interactions with its environment. Thereby, the scope mediates between internal aspects, such as resources and capabilities, and relevant external factors such as the macro-environment of technological, economic, social and political factors and the micro-environment describing the local environment under which the company operates. In interaction with internal aspects, the relevant external macro- and micro-environment has an impact on the determination of an organisation's objectives and goals [19], [29]. According to the resource-based view of strategy, competencies, capabilities and other types of *resources* are important to an organisation's strategy, as they enable a company to conceive of and implement strategies that improve its efficiency and effectiveness [30]. The organisation's resources are a fundamental determinant of *competitive advantage* and performance. The strategy itself most importantly aims to create a competitive advantage, increasing the difference between the economic values of the organisations and its rivals [31]. *Synergy* refers to the alignment and reinforcement of resource deployments and interactions across different levels of the strategy [28]. Within an organisation, different levels of strategies and objectives occur, most commonly represented by functional, business and corporate strategies. A sixth element was added to Hofer and Schendel's [28] list, as it was recognised as an important component from literature. According to Lynch [29], strategy formulation is a dynamic process caused by the continuous change of the organisation's resource or environmental shifts, the strategy has to respond to. Therefore, a continuous *revision* of the strategy is needed.

1.2 Strategy Formulation

The components of a general strategy described above are closely linked to its formulation, which is typically of a procedural nature. A structured strategy formulation process supports companies in addressing the above-mentioned aspects [28]. Strategies in the formulation process can be viewed from different perspectives, which Mintzberg et al. [32] divided into ten schools, each of which takes up one adjective of a strategy.

Phaal et al. [33] compared different strategy formulation processes and synthesised their commonalities into a generalised process. According to this, the process, which is simplified in theory, consists of the following six steps (see Figure 1):

- (1) *Vision* and *goals* are formulated to give the strategy a direction.
- (2) The past strategy and *current position* of the organisation is identified based on the formulated visions and goals.
- (3) Information about *external and internal environments* is collected and evaluated in terms of opportunities, threats, weaknesses and strengths.
- (4) *Strategic options* are derived.
- (5) The strategy is *implemented*.
- (6) The strategy is continually *evaluated*.

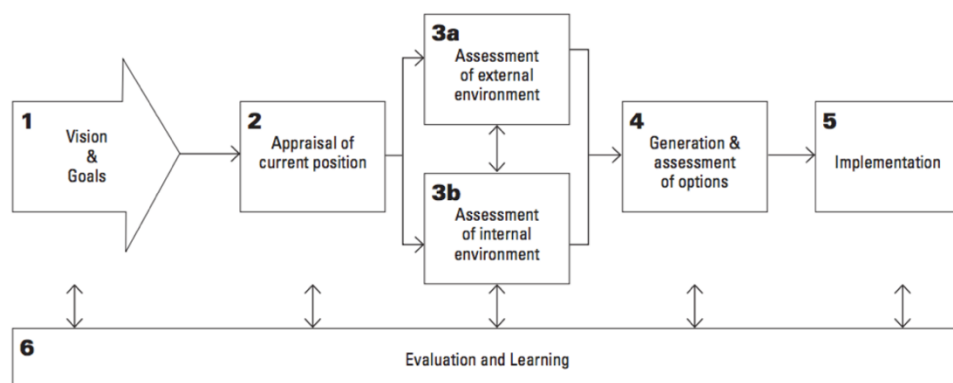


Figure 1: Strategy formulation process according to Phaal et al. (2010)

1.3 IP Strategy

Because IP assets and the underlying knowledge are becoming increasingly important for building, maintaining and growing competitive advantage, corporate strategy should recognise IP as an important part [7], [12]. The management of IP has become increasingly relevant for technology-driven companies, moving from a legal to a strategic issue [34]. Whereas core elements of strategy have been discussed in section 1.1, the nature of IP strategy in particular is considered in the following sections. The literature identifies different specific aspects, which are particularly important for formulation of IP strategies.

1.3.1 Objectives

As for strategies in general, IP strategies also include objectives. These objectives of IP strategies have been discussed under many topics using different terms: the objectives of IP e.g. [35], [36], the roles of IP [6], [35], [37]–[39], or different motives to apply for IP eg [40]–[43].

The primary role of IP has usually been the protection of the company's own innovations from imitation to increase the economic returns [6], [40]. Concurrently, additional opportunities to benefit from IP have been discussed through time by many authors as Porter [19], who considered IP as a potential barrier of entry and Fisher and Oberholzer-Gee [9], who discuss options for companies to use IP to exercise market power or collaborate. A dominant role of IP has thereby been on the objective of appropriability and capturing value, created within an organisation. However, IP can additionally be considered for leveraging the creation of value [9]. For example, patents can be used by companies to access external financing through various ways such as venture capital, collateralised debt and IPO valuation, which can help companies sustain a high level of R&D activity [44]. IP can also be used to motivate personnel with incentives and encourage innovation for value creation [45].

In recent years, technological change, higher costs and risks of innovation have forced companies to consider cooperation, networks and open innovation approaches to knowledge and complementary technologies as potential objectives of IP for competitive advantage [46]–[49]. Holgersson et al. [50] suggested that appropriability needs to be expanded to a larger context of an ecosystem which involves different actors, and institutions. Thus, the formulation of objectives within the framework of the IP strategy correlates with the necessary aspect of scope of a general strategy. In fact, it has been shown that patents are even more relevant in open innovation projects than in the classical “closed” innovation processes, but are rather seen as enabler for the collaboration, particularly with emphasis on licensing agreements (REF needed). It thus appears to be reasonable to conclude that IP strategies specifically support objectives to maximise value creation and value capture, and thus support the overall goal of competitive advantage within business and corporate strategies.

1.3.2 Multiple IP assets

IP can take various forms, which differ in their scope, applicability, legal framework and other characteristics. To define IP, it is necessary to discuss the concepts of intellectual capital and assets. In a broader context, intellectual capital refers to the intangible value of a business, which enables it to function and be competitive. Part of the intellectual capital are networks, experiences, skills or intellectual assets such as drawings, processes, reports and others, which bring intellectual capital into a tangible form [51], [52]. Part of these intellectual assets is intellectual property, which is commonly referred to as creations of the human mind, such as inventions, literary and artistic works, designs and symbols, and is protected by law [53]. A general distinction of IP can be made between formal IP (legally protected intellectual assets), such as patents, design rights, copyrights, trade secrets and trademarks, and informal IP (alternative appropriation mechanisms of intellectual assets, protected by contracts and common-law, such as licensing agreements for managing relationships) [52], [54].

In order to support formulated objectives, both formal and informal IP types must be taken into account [50]. Due to their individual characteristics, each IP type has advantages and disadvantages for the achievement of the individual objectives. The decision on the best type of IP for supporting objectives may depend on different factors, as the size of the company, type of value proposition, or available resources of the company [55], [56]. Granstrand [6] suggested that patents, trademarks and copyrights can be combined to provide multi-protection and hence highlighted the growing need to consider IP types for complementary usage. Thus, IP assets are the specific resources of IP strategy, whose deployment contributes to the implementation and drawing of this strategy that then needs to be aligned with higher, top-level ones, such as business and corporate strategies.

1.3.3 IP Strategy domain

The existing management-focused literature classify IP strategies in separate domains [14], [36], eg [57], [58]. Somaya [7] suggests that IP strategies guide decision making about resource deployment and allocation of patents, which primarily occur in three interdependent domains of activity: *rights*, *licensing and enforcement* and are to be used to realise companies' objectives. *Rights* refer to actions which include internal and external acquisitions, renewal, reissue and maintenance of IP assets, aggregating the IP portfolio. The *licensing* domain, better described as exploitation of IP strategy, aims to utilise IP, by eg selling, internally exploiting or licensing-out IP assets [36]. Next to these three generic utilisation mechanisms of licensing, other detailed options such as standard setting, cross-licensing or open innovation can be realised [7]. For these exploitation mechanisms, the strength of IP and access to complementary assets need to be considered [3], [59], [60]. Within the third domain of *enforcement*, companies strategically use or threaten to use litigation to stop infringers or pay royalties [7]. The three domains proposed by Somaya [7], are also implicitly included in the frequently mentioned "IP value chain" concept, which can be perceived as a series of steps, similar to the value chain concept, spanning from acquisition and generation over

protection to exploitation and enforcement of IP [8], [12], [13], [61]. Thus, the domains outline the possible utilisation of IP resources.

1.3.4 Strategic alignment

Corresponding to the requirement of synergy in generic strategies, there is a common agreement about the necessity to align an IP strategy with the company's top-level strategy to leverage value maximisation eg [8]–[10], [12], [13]. The formulation of specific IP strategies should therefore take place after the formulation of business objectives enabling IP-alignment and improvement of competitiveness [5]. Several frameworks have been proposed to support the alignment of IP strategies. Reitzig [13] suggest classifying IP strategy into the three domains of acquisition and generation, protection and exploitation and enforcement and handling them across the organisation's strategy levels. Fisher and Oberholzer-Gee [9] present a map helping to decide which options a company should choose to extract value. However, these frameworks lack a process to apply alignment in practice.

Summarising the literature on strategic alignment for IP strategies, three different levels for alignment can be identified:

- (1) As already discussed in section 1.3.2, multiple IP assets should be considered complementary from an IP portfolio perspective including patents, trade secrets, trademarks etc.
- (2) Because IP strategies are used across different units in an organisation, the coordination of the IP strategy execution can be facilitated by its alignment across the organisation.
- (3) IP strategies, like other strategies, must adhere to the three strategy levels of organisations, which are constrained by each other [28]. Therefore, IP strategy must be aligned under the functional, business and corporate strategy.

1.3.5 Summarising the relevant aspects of IP strategy, a common understanding of the concept can be created. Responding to the key components of strategy and based on the reviewed literature on IP strategy and highlighted aspects, we define IP strategy as following:

IP strategy guides long-term decisions regarding acquisition, maintenance, exploitation and enforcement of formal and informal intellectual property (rights), to maximise value along an organisation's value chain in support of and thus in alignment with its business objectives.

1.4 IP Strategy Formulation

Relevant existing literature for developing an approach for formulating IP strategies is reviewed in this section. Formulation approaches from the topics such as 'patent project management' eg [62] or 'IP portfolio management' [14], eg [63], [64] are discussed. Most literature, however, focus on operational processes for the daily management of IP rather than long-term IP strategy formulation.

Only very few authors have actually proposed structured approaches for IP strategy formulation. Gollin [14] presents a four-step process model to formulate an IP strategy by (1) defining the organisation's overall goals, (2) assessing internal resources, (3) evaluating the competitive market and finally (4) form a simple, long-range IP management plan based on the previous results. Sullivan and Harrison [38] propose a similar three-step process model, which states that organisations need to identify their business objectives, determine the roles that IP can play based on the business objectives and thus select suitable IP, and then take corresponding actions tailored specifically to unique business needs. Kuffer et al. [15] introduce a loop-based process model comprising the identification of market needs, the anticipation of technology and product trends, the evaluation of IP players in the field as well as their IP assets, and the generation of corresponding IP options. A process model proposed by Jones [65] , starts with understanding the business and IP position to align the IP strategy, followed by a determination of the IP mission

and desired IP position to establish a strategic direction. The third step encompasses the formulation of goals and subgoals followed by finally sharing the strategy to gain support from collaborators.

As described above, specific IP strategy and general strategy are similar in terms of their composition and formulation process. However, the literature on IP strategy formulation and its support by processes and tools is very limited. Despite existing approaches, IP is still commonly poorly managed. This may be due to the complex and interdisciplinary nature of IP strategies, which requires a lot of knowledge, not the least about the different types of formal and informal IP with its different legal systems and mechanisms. In addition, successful formulation may also fail due to communication and dialogue between relevant experts as IP professionals and business executives, who often have different roles, tasks and approaches [9], [10]. We find that the existing approaches do not offer enough detailed support for formulating effective IP strategies. However, various management tools exist for formulating strategies that focus on other assets, for example roadmapping for technology strategies. We thus set out to develop a practical business tool that can support the formulation of IP strategies to solve the problem and close the gap.

2 Methodology

As IP strategy formulation demands an increase of general understanding about this complex phenomenon with only limited theories, this research should be exploratory and theory-developing by nature, requiring the researcher's interactions and interpretations of the reality [66], [67].

For the development of a business tool in particular, a participatory approach with extensive engagement of relevant stakeholders is important. According to Patton [68], action research (AR) is usually applied to solve pertinent problems in an organisation requiring collaboration between researchers and local stakeholders to seek and enact solutions to problems [69]–[71]. Based on the work of Platts [75], who pioneered a procedural action research approach addressing the dual

goals of developing theory while providing practical support to the collaborating organisation [72], Ilievbare et al. [73] proposed a framework and methodology for creating business tools and processes. The methodology consists of six stages (see Figure 2):

- (1) Definition
- (2) Design
- (3) Development
- (4) Testing
- (5) Assessment and refinement
- (6) Deployment

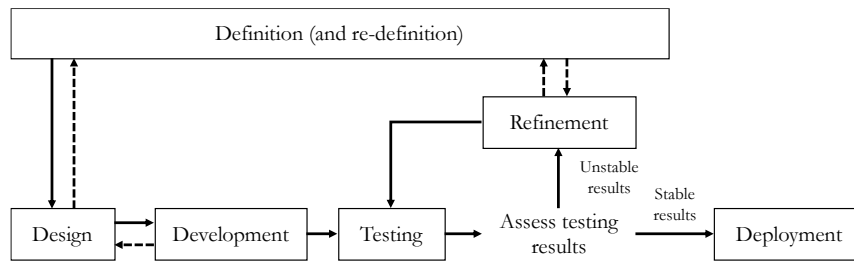


Figure 2: Business tool development process according to Ilievbare et al. (2016)

Within the preliminary and preparatory *definition* phase of the tool development, the purpose and scope of the tool, as target customers, users and input and output should be defined. Additionally, as a basis for the conceptual design, the business need, case and theoretical underpinning should be covered. Thirdly, the completed package of the business tool, as background reading, manual or auxiliary tools should be considered, to provide the tool facilitator's perspective [73]. For this phase, 10 exploratory interviews were conducted with IP and roadmapping practitioners to verify the relevance of the study and the feasibility of the proposed approach (see Appendix A). Additionally, the reviewed literature served as complementary source.

The actual creation of the tool can be divided into two process steps, the design of an initial sketch and the subsequent detailed development. Within the *design* stage, a retrospective approach was

chosen by reviewing the literature about IP strategy and strategy formulation tools. We decided to select the roadmapping tool for formulating IP strategies because it has been shown to be a flexible approach that been successfully adopted for formulating a wide range of different strategies across numerous sectors [74]. As a result, the generic layer-based and time dependent roadmap structure was adapted as a template, which was adapted to integrate individual aspects of an IP strategy, whereas the formulation process of an IP strategy is involved implicitly by completing the template layer by layer. Choosing to adapt an existing approach to fulfil the purpose rather than creating a completely new one, was found important [73].

The detailed *development* of the tool aims to transform the initial sketch into practical procedures to enable efficient transformation of inputs into outputs [73]. The development was conducted by 7 60-120min long interviews with industrial practitioners who were familiar with IP, followed by 3 interviews with roadmapping practitioners who already participated in the definition stage (see **Error! Reference source not found.**). The interviewees provided suggestions for a detailed elaboration of the initial idea of the IP roadmapping framework and its template and process.

After the creation of the first version of the tool, *testing* is crucial for ensuring validity and enabling adoption in industry. The assessment improves the effectiveness and efficiency of the tool and can be divided into two stages, consisting of (1) a subjective assessment through experienced practitioners or tool's potential users and (2) the application of the tool in a number of practical cases [73]. As described in Figure 2, the testing process is iterative to enable continuous improvement and reduce the number of required changes to the tool to reach stability. The subjective assessment was carried out by 17 one-to-one engagements and focus-groups to enable the elimination of obvious deficiencies. This was followed with practical cases that were used to address any deficiencies missed in the subjective assessment and test the tool in a natural environment. The case studies were realised by 14 workshops, accompanied by follow-up

questionnaires and capturing participant observations. 0 shows the iterative process consisting of three main cycles with practitioners and case companies.

Due to the large variety of business tools, there are no universally agreed on test criteria [73]. However, a tool may be tested on the basis of the effectiveness with which it meets its own objectives. With the aim of better describing the effectiveness of a tool, Platts [75] suggested three criteria for tool assessment, which were used for this research: feasibility (the ability to follow the process as intended), usability (ease of using the tool) and utility (usefulness to generate action plans).

Based on the conducted assessment cycles, iterative *refinements* took place, based on the testing results collected via participants feedback and observations. After each cycle the tool was refined, and the different components were optimised until a stage of stability, a considerable reduction in the number of necessary changes, was reached [75].

For instance, feedback received suggested the sequencing of the roadmap layers be changed to make the strategic landscape layer and IP options layer adjacent to each other for better alignment. Hence, the initial order of the layers were changed from top to bottom along the steps to the final layout.

3 Roadmapping for IP Strategy Formulation

The business tool described in the following sections is the result of the research approach presented above. The adapted roadmapping-based IP strategy formulation approach consists of two main components: (i) a process and (ii) associated template. First the roadmapping technique is presented in some detail, followed by a detailed presentation of the process for the formulating IP strategies.

3.1 Roadmapping as suitable framework

The roadmapping technique is a powerful tool for supporting technology foresight and innovation planning [76]. Although it originally emerged more than three decades ago as ‘technology’ roadmapping for the identification of technological solutions, the approach was generalised for other purposes, and can more be more appropriately termed ‘business’, ‘strategic’ or ‘innovation’ roadmapping for general application, as technology is only one of its aspects [77]. The condensed structured visual format of roadmaps provides a strategic lens for complex systems, incorporating all key perspectives and enabling the formulation of consensus and aligned actions and the identification of challenges, risks and tensions [16]. The strategic lens includes the structured roadmap architecture representing the information stored in time-dependent layers and the graphical format enabling flexibility and comprehensive communication [16].

Next to the template, the roadmapping technique also consists of the collaborative process of filling out the template involving a group of domain experts [78]. This roadmapping process is as important as the roadmap itself, because it facilitates discussion and learning around the development of the roadmap [74]. To implement the process, workshops have been identified as a suitable method enabling key stakeholders to interact with each other, collect diverse information through divergent, creative activities and communicate the relevant focus [76]. Workshops are flexible, scalable, rapid and efficient [79], [80]. They were therefore used as a demonstration method.

The roadmapping technique has been chosen within the design phase, as it is particularly suitable for IP strategy formulation due to several reasons:

- (1) The multi-level approach of roadmapping enables the strategic alignment of IP on different levels of the system, which supports strategic initiatives and tactical decisions [81].

- (2) The finished roadmap template as well as process enable the effective communication of key strategic information to internal and external stakeholders as well as across different units of the organisation ranging from engineers, lawyers and executives [77]. The visualisation supports managerial thinking, communication and coordination while simultaneously increasing motivation and engagement of peers, which are important factors during strategizing [82].
- (3) IP strategy requires time-dependent decisions, such as timing and sequencing decisions, for strategic alignment because of the limited duration of IP rights and eg the timing of filing [62]. Therefore, the explicit element of time in roadmaps is essential.
- (4) The layer-based architecture of a generalised roadmap can be used to form the layers of an IP roadmap corresponding to the IP strategy definition. The individual layers enable the explicit consideration and alignment of the strategic landscape with the IP supported business objectives ('why'), multiple IP assets ('what') and operational IP strategies ('how') while simultaneously considering the timing ('when'). These knowledge types correspond to the traditional strategic roadmap [16].

3.2 The IP strategy formulation process

The generic process for the formulating IP strategies is presented in the following. The individual layers of the template are filled out along the process. The process was adapted based on the general roadmapping process for strategy development proposed by Ho [83] . The adaptations were derived from the literature reviews of IP strategy (formulation) and the methodology described in section 3. The process for IP strategy formulation is shown in Figure 3 and consist of three main phases composed of six different steps: A preliminary step for the preparation of the workshop in the first phase, four consecutive steps during the workshop in the second phase, and one follow-up step summarising a narrative and formulating a time-dependent strategy in the third phase.

Corresponding to the process, a template is used to communicate and visualise (intermediate) results. Figure 4 shows the template, which is made up of a stack five horizontal layers, representing the five analytical and summarising steps. These layers are completed along the process in the sequence indicated by the numbers shown on the left. A detailed explanation of each step is presented below. The horizontal axis of the template delineates time horizons. Typically, these are three time horizons (Horizon3): short, medium and long term.

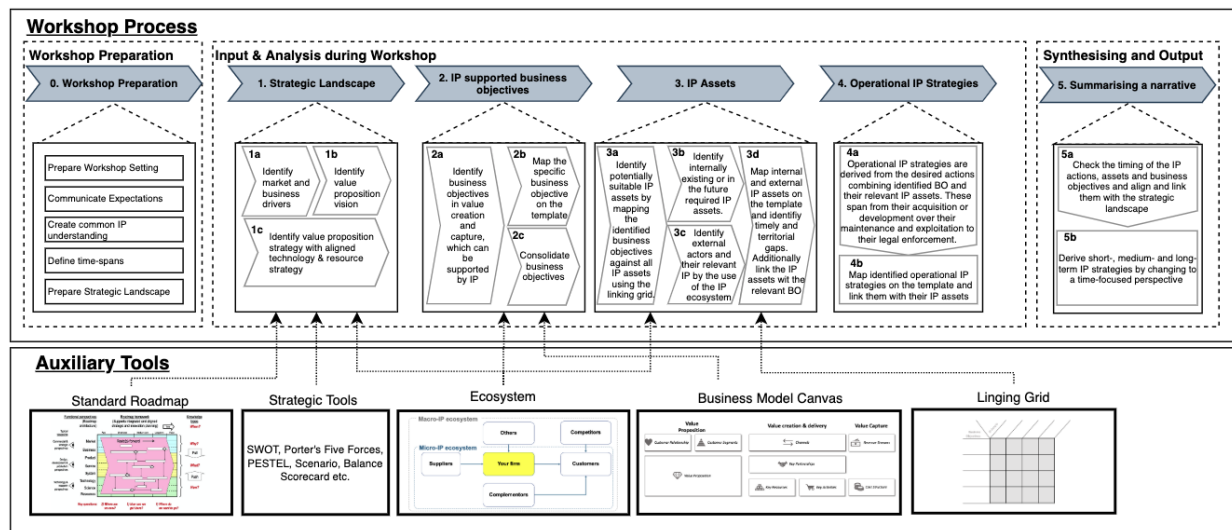


Figure 3: IP strategy formulation process

Step

1

4

3

2

5

		Past	Now	Short-term	Medium-term	Long-term	Vision
Strategic landscape							
Market/Business		Step 1a Market-, business drivers and client's needs					
Product Service System		Step 1c Product-Service System strategy with aligned technology & resource strategy					
Technology/Resources		Step 1b Vision of future offering as core products and services					
Operational IP strategies							
Acquisition	Internal						
	External	Step 4a Operational IP strategies to determine how IP assets can be used to meet business objectives					
Maintenance		Step 4b Fine-tune IP strategy by aligning time-stamp and linkages					
Exploitation							
Enforcement							
IP assets							
Step 3a Use linking-grid to identify potentially relevant IP types.	Own IP	Step 3b Internally existing and future required IP assets to support business objective					
Other players' IP	Positive	Step 3c Externally existing relevant IP assets with positive and negative effect on business objective					
	Negative						
IP supported business objectives							
		Step 2 Specific business objectives, IP can support					
Summarising narrative							
Step 5 Synthesising key messages in short-, medium- and long-term							

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Figure 4: IP strategy template

3.2.1 Step 0: Preparation

Before the template can be filled out collectively during the workshop and thus the strategy formulation of IP can begin, preparatory steps must be taken. It is necessary to define the scope, focus and unit of analysis for the IP strategy. Participants of the workshop should be determined, ideally coming from different relevant areas of the organisation. In fact, the mix of workshop participants is critical to the success of the IP strategy formulation process. It was found to be particularly helpful if the workshop team consisted of a core group of participants that represent and thus have deep insights into three functions: the companies business objectives (eg CEO), technologies (eg CTO), IP portfolio (eg head of patent department). As IP assets are often dispersed across functions, particularly in larger firms, it was also found to be helpful to involve colleagues from the marketing department (that often looks after trademarks), the software

engineering team (often involved in copyright licensing), but also the general legal team (that looks after contracts, ie more informal IP).

A broad team was found to help later to effectively communicate the resulting IP strategies across relevant business units. Furthermore, a certain level of understanding of strategy and IP management among the participants was found to be very helpful to avoid ambiguity and increase the utility of the tool.

To facilitate the process, information, which is necessary to fill out the template should be collected and prepared beforehand. In particular, information about the strategic landscape, its time horizons and the existing information about relevant external and internal IP (eg IP rights, expiration dates, ownership) should be gathered. This is particularly relevant so workshop time of can be used mostly for value adding discussions instead of clarification and information gathering. Finally, in this first phase it is helpful to communicate the expectations of the workshop to get a picture of the desired outcome and prepare the workshop setting. Overall, providing examples have been found useful to create a common understanding and communicate expectations.

3.2.2 Step 1: Strategic landscape

For the first ‘real’ step of the workshop, the information collection in the previous step is used to jointly map and reflect on the strategic landscape of the organization on the top layer of the template. By formulating specific business goals, the organisation can then take a business perspective on IP management in the next steps and define what can be gained from a strategic approach to IP. Additionally, this step sets the scene for enabling the strategic alignment of the formulated IP strategy to the overall goals of the organisation. The strategic landscape maps the market and business drivers that relate to the organisation’s overall goals or purpose. Based on this, the long-term value proposition / vision is formulated, which response to the market and business layer. Depending on the organisation, the value proposition can consist of products, services, or a combination of these. The necessary value proposition and technology and resource

strategies are then developed retrospectively. The external and internal resources and technologies necessary for the realisation of the value proposition must be identified.

Established strategic tools such as SWOT, PESTEL, or Porter's Five Forces analysis can be used to support this step and consider the ecosystem of the organisation. The use of an already existing top-level roadmap is also very helpful. For screening the environment that has an impact on the organisation and increasing the awareness of the participants about the actors that have an impact on the IP strategy, the ecosystem should be explicitly identified and considered during this step. Therefore, an ecosystem mapping template can be used as auxiliary tool. Figure 5 shows an example of such template.

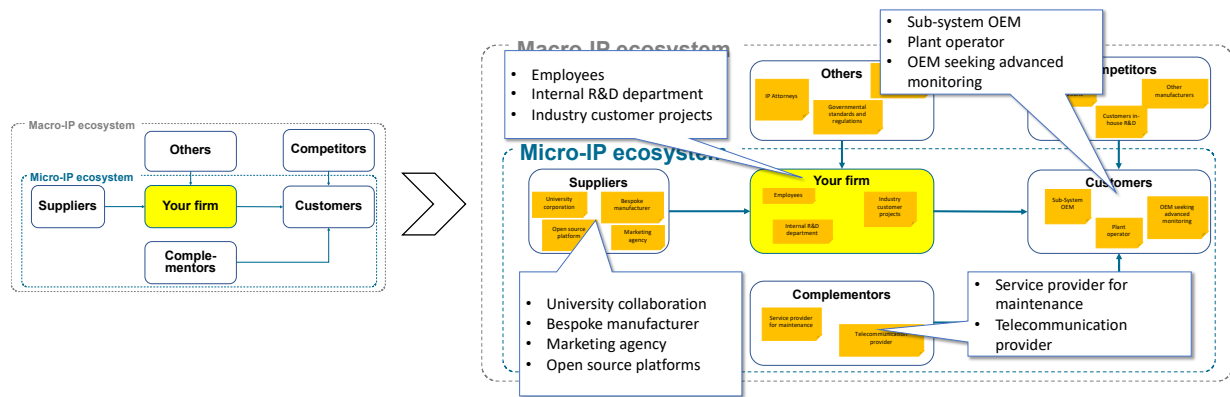


Figure 5: Ecosystem mapping with example of sensing technology company

3.2.3 Step 2: IP supported business objectives

After the top-level strategic landscape of the organization is captured in the previous step, the functional role of IP and its objectives are identified in this step. As already described in chapter 2, IP can fulfil various functions in an organisation. The main areas IP can leverage are the value capture and creation within an organisation [9]. As described by Nußholz [84], the value capture lies within the cost structure and revenue streams of an organisation, which can be influenced by different means. Value creation instead, can occur in the areas of partners, channels, activities and resources with the organisation.

In order to align the strategic functions of IP with the top-level strategy, in this step specific business objectives are derived from the strategic landscape which can be supported by IP. For instance, to improve the next product generations, the sensing technology company might seek electronics to survive the environment and enable long-time monitoring. This could eg allow justifying charging premium prices. To facilitate a holistic consideration of the entire organisation and enable the maximisation of value, the business objectives can be derived while considering the business model canvas from Nußholz [84] with its elements and the categorisation of value capture and creation. It allows the consideration of different value dimensions as well as external and internal perspectives. The abovementioned example could be found in the area of key resources (specific electronics), value proposition (long-term monitoring) and revenue generation (premium prices). Furthermore, the ecosystem should be considered to ensure the consideration of the strategy scope and relevant actors.

When filling out the bottom layer of the roadmap template it is important to formulate business terms as precisely and concisely as possible in order to reflect the functions of IP for all participants in the best possible way. In addition, this helps to avoid unnecessary complexity in the further procedure. By consolidating all formulated business objectives at the end of this step, duplication, similarities and ambiguities can be detected and resolved.

3.2.4 Step 3: Suitable IP assets in their ecosystem

The third process step focuses on the identification of individual types of IP assets and aims to find linkages and gaps between the currently existing IP portfolio and the IP portfolio needed in the future to support the business objectives in the best possible way. Internal and external IP assets as well as different types of IP should be considered. In preparation for this step, it was found helpful to plot the previously identified business objectives in a linking grid against potentially usable IP types and thus evaluate the suitability of the individual types. This allows a complementary analysis of different IP assets (see Figure 6).

Business Objectives	IP Assets	Patents	Copyright	Trade Secrets	Etc.
Acquiring/ Developing specific electronics	X	X	X		
Etc.					

Figure 6: Linking grid showing one example

As described in section 2, different formal and informal types can be used for the same purpose or complement each other. To continue the example, for the acquisition or development of the specific electronics, it might be necessary to license-in externally owned patents and keep the selection of the components as internal trade secrets. Additionally, internal know-how in electronics design and the associated copyright can support and protect the internal development. In addition to the participating company's own IP assets, the landscape of other players' IP in relevant fields should be identified. The information can be captured, for instance, through a patent analysis and support decision-making during the workshop session. For example, the relevant externally owned patents might expire soon. Following this example, the own relevant IP assets supporting the business objectives as well as those of external actors are mapped onto the roadmapping template and linked to the business objectives.

3.2.5 Step 4: Operational IP strategies

After the suitable IP assets have been identified for the support of business objectives, during this step, applicable IP actions (or operational IP strategies) are formulated correspondingly. These actions correspond to the business objectives considering the timely and territorial linkages and gaps in the IP portfolio spanning across the IP strategy domains. Operational IP strategies occur in the domain of acquisition (internal and external), maintenance, exploitation and enforcement. As IP is by nature territorially and often timely limited, the determination of the 'where' and 'who'

and ‘when’ of the individual IP is crucial during this step. Additionally, the continuous consideration of relevant ecosystem players is important as they sometimes are directly addressed by the operational strategies. During this step, details for each action is captured. The company might decide to license in the patent for the short term, until it expires and simultaneous build up know-how around the patent to further improve the technology in the future and sell the improved sensor. The improvement could be accompanied by the development and enforcement of internally owned copyright and the maintenance of trade secrets. These actions are then mapped onto the template considering their individual timestamp.

Before going over to the last step, the time stamp of the operational IP strategy is fine-tuned to ensure the support of the business objective at just the right time. The timing and sequence of operational IP strategies are especially important as there are particularities, which need to be considered. For example, the successful patent application process might take a considerable amount of time, and all IP needs to be aggregated before product launch. Additionally, trade secrets can be turned into patents, but not the other way around. There are many other examples eg concerning the patent expiry and duration of protection of IP types, which highlight the need to consciously consider timing and sequencing.

3.2.6 Step 5: Synthesising IP strategies

The final step of the workshop is to summarise the formulated IP strategy. This allows the conversion of operational tasks into a time-dependent narrative of IP strategy for the users of the formulated IP strategy. The individual time horizons are considered and based on the strategic landscape, IP actions to support the identified business goals and their IP assets are summarised. The short-term IP strategy usually aims to respond to current characteristics of the company within the next six months to a year and determines where the company currently is, whereas the medium-term IP strategy commonly applies more permanent solutions to short-term problems within the next two to three years. In the long-term the company commonly aims to respond to drivers and

the competitive situation and sets the overall direction for the company within the next five years and more. Thus, the medium-term IP strategy shows how to achieve the goal formulated for the long-term IP strategy. For this step it is important that in the previous steps the individual elements are connected by lines to make linkages across layers explicit. This gives the visual possibility to identify connections between the different levels and individual actions, their IP assets, the business objectives and their underlying top-level strategy.

Finally, it should be mentioned that the roadmapping process is a continuous process due to the dynamic environment and should be repeated and refined in intervals that suit the individual organisation's context. In fast moving consumer good or software development companies these might be more frequent than in pharma companies with much longer planning horizons. It is important to continuously review and revise the roadmap through evaluation and learning, in order to keep it useful for any changes in the future.

3.2.7 Workshop Setting

As the workshop itself is the facilitator of the process, it is very important for the formulation of an IP strategy. In addition to the steps already described, some important aspects for its implementation have emerged from the research.

As this is a relatively detailed process, it is advisable to plan enough time for it. Experience has shown that at least one day, preferably two, is needed to penetrate the matter sufficiently. Depending on the time available, detailed work on the auxiliary tools is possible. In order to save valuable discussion time during the workshop, it helps to provide necessary supporting information about important concepts, the process or examples for preparation before the workshop. It ensures that a sufficient level of knowledge about IP exists to use the tool successfully. A common understanding of the workshop goal should be agreed upon and communicated so that the participants see the big picture. Furthermore, it is helpful to use non-

academic terms to increase comprehensibility during the workshop and to involve all participants in the discussion.

The workshop can be conducted in person using large printouts and post-it notes, or online using online conference tools and digital whiteboards. In this case, however, the moderating role in facilitating the discussions should be emphasised. In addition, the moderating role should ensure that a common, comprehensible terminology is used. Due to the different backgrounds of the participants and the complex subject matter, this is recommended and eg supported by the use of explanatory watermarks.

4 Conclusion

This paper provides a theoretical understanding of business-aligned IP strategy and presents a roadmapping-based business tool for the formulation of IP strategies. Thereby, it responds to the two problems identified: the lack of a definition of the IP strategy concept impeding its embedment into corporate strategy and the scarce literature on IP management tools supporting organisations in formulating IP strategies. The adapted general strategic roadmap enables the formulation of an IP strategy, which provides guidance of operational plans but also considers the abovementioned elements of IP strategy (see chapter 1.3) and aligns them with the corporate strategy. These findings have practical implications as well as limitations which are presented jointly with recommendations about future research in the following.

4.1 Practical implications

Besides its contribution to the conceptualisation of the IP strategy in the literature, the business tool presented in this paper has mainly practical implications. The case studies conducted show that this tool can help organisations, large and small to formulate IP strategies without the need for too many resources. It facilitates structured conversations between participating experts from

different fields, who often have difficulties in doing so. Due to the variety of companies that participated in the case studies, the applicability of the tool could be shown independent of the size of the company and its industry. In fact, IP management is often attributed to be a tool mostly for large, resource intensive firms. However, this tool has proven to also work for smaller firms. However, it was also found that especially companies that have no experience in IP management and need external support, such as SMEs or start-ups, benefit from the approach.

Besides the use within the company, the tool is also suitable for the use of consultants. As the approach requires a certain level of expertise about IP, its strategy understanding and management among the participants, external advisors are helpful to stimulate discussions.

4.2 Limitations and future research

Due to the chosen methodology, the generalizability of the approach is only permissible to a limited extent. Due to the limited number of case studies, the completed tool could not be tested sufficiently for its effectiveness by determining how the tool has been used and how the characteristics of the users might have influenced it. Further applications of the tool, eg in the context of consulting or independent adaptations by companies, would increase the maturity of the tool and enable market acceptance [77].

Furthermore, the feedback indicated that a strong generalisation of the tool prevents a possible specialisation for individual company sizes or industries. Due to different characteristics of the industry, eg the patent-focused pharmaceutical industry compared to the service sector, a specialisation might enable a focus on specifically important aspects of the IP strategy. It was suggested that such a specialisation can yield additional benefits. However, while the process and template can be adjusted to fit the specific context, we found strong indications for its general suitability for formulating IP strategies.

While developing the business-tool, the action research approach might cause problems associated with the path dependence, stating that there is a risk that at some point no more changes are able to be found from the assessment procedure because one is stuck on a particular trajectory, such as framework architecture in this research. There is a danger that only small changes are made to the tool and that the fundamental design is no longer questioned. This results in the need for continuous evaluation even after acceptance in the market.

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Appendix A Exploratory Interviews

TABLE I
PROFILE OF PRACTITIONERS WHO TOOK PART IN THE EXPLORATORY INTERVIEWS

Practitioner	Profile
1 (06/2016)	Patent analyst at a UK-based IP research firm providing search services and helping their clients develop related strategies.
2 (06/2016)	Innovation director who was also responsible for IP strategy development at a UK-based drug delivery, formulation and manufacturing technologies company. Previously worked at different organisations in the industry, with over 20 years of experience.
3 (07/2016)	IP manager at an international fingerprint identification technologies company. Previously a patent manager at one of the largest international semiconductor and telecommunication equipment companies.
4 (07/2016)	Founder at a UK-based IP consulting firm providing consultancy, search and training services. Previously worked at several technology companies and consulting service firms, with over 20 years of experience.
5 (07/2016)	CEO at a UK-based software company using AI for organisations' IP management, with over 20 years of experience in IP.
6 (07/2016)	CTO at a UK-based IP firm providing strategic advisory services to maximise value from organisations' innovations. Previously worked at several UK-based business consulting firms and medical products companies, with over 30 years of experience in both technical and IP areas.
7 (08/2016)	IP valuator at an EU firm providing strategic value management and finance of IP, with more than 10 years of experience in IP and roadmapping.
8 (10/2016)	Consultant with more than 10 years of experience providing a roadmapping service for strategy development, innovation and technology management.
9 (10/2016)	Consultant with expertise in roadmapping for innovation and technology management.
10 (12/2016)	Industrial associate at consulting firm with more than 20 years of experience in developing business and technology strategies (also expertise in roadmapping). Previously held three MD roles in the electronics industry and a consultant role in a large technology consulting firm.

Appendix B Development Interviews

TABLE II
PROFILE OF PRACTITIONERS WHO TOOK PART IN THE DEVELOPMENT STAGE

Practitioner	Profile
1 (10/2017)	Innovation director who was also responsible for IP strategy development at a UK- based drug delivery, formulation and manufacturing technologies company. Previously worked at different organisations in the industry, with over 20 years of experience.
2 (10/2017)	IP manager at an international fingerprint identification technologies company. Previously a patent manager at one of the largest international semiconductor and telecommunication equipment companies.
3,4,5 (11/2017)	CTO, Director of IP and patent portfolio analyst at a UK-based technology company mainly focused on display technologies. The CTO had over 20 years of experience in the industry with a good knowledge of IP. The Director of IP had over 30 years of experience in all major aspects of IP. The patent portfolio analyst had more than 10 years of experience in project management and innovation.
6 (12/2017)	Head of IP at a multinational conglomerate company and one of the largest industrial manufacturing companies' UK office, focusing on the areas of electrification, automation and so on. Previously a patent attorney working for different organisations and companies.
7 (12/2017)	CEO at a UK-based technology company focusing on motor sports, automotives, public transport and healthcare. It was run as an internal R&D department, rather than a standalone business prior to the CEO joining. Previously at different large international technology companies and consulting firms, with over 40 years of experience.
8,9,10 (12/2017)	See practitioners 8-10 in Table I.

Appendix C Testing Cycles

Strategic technology and innovation management consortiums (STIM) 2016, STIM 2017 and STIM 2018 were attended to approach practitioners for interviews and obtain access to in-company cases. Feedback was also collected at poster presentation sessions. In addition, conferences were attended to obtain feedback from academic perspectives. None of this feedback is included in the table as formal interviews.

TABLE III-A
INTERVIEWS AND IN-COMPANY CASES FOR THE TESTING AND REFINEMENT STAGE

	Interviews		Case Studies	
	Practitioner/ Case company	Profile	Practitioner/ Case company	Profile
Iteration Cycle 1	1 (01/2018)	IP manager at a UK-based AI company focusing on clinical development. Previously worked as patents analyst and technology specialist in different large international companies, with over 10 years of experience.	1 (08/2017)	Retrospective roadmapping session with one IP manager; the company was medium sized and focused on finger printing technologies.
	2 (01/2018)	IP manager at a large multinational technology company providing telecommunications equipment, with over 20 years of experience.	2 (10/2017)	Roadmapping session with CEO; the company was a start-up focusing on monolithic MOFs.
	3 (01/2018)	CEO at a China-based technology company focusing on flashlight technologies, with over 10 years of experience.	3 (01/2018)	Roadmapping session with CTO, IP manager, and Innovation director; the company was one of the top display technology providers and planned to enter healthcare industry.
	4 (03/2018)	Technical Director at a multinational technology company focusing on infrared and ultraviolet emitters and components. Previously worked as senior manager in different large technology companies, with over 30 years of experience.		
	5 (03/2018)	Vice President of Engineering at a multinational company providing Automation Solutions and Commercial & Residential Solutions (product manufacturing and engineering service)		
Iteration Cycle 2	6 (06/2018)	Head of IP at a multinational conglomerate company and one of the largest industrial manufacturing companies, focusing on the areas of electrification, automation and so on. Previously a patent attorney working for different organisations and companies.	4 (03/2018)	Hypothetical roadmapping session with the Intellectual Property Office of Singapore (IPOS) IP consultancy teams; 17 attendees including the Director of IPOS's Legal Department, the Head of IP Management and members of the team that provides patent analytic services to industry.
	7 (06/2018)	Director at a multinational pharmaceutical company with about 20 years of experience.	5 (04/2018)	Roadmapping session with CEO, IP consultant; the company was a subsidiary of a large conglomerate and focused on motor sport, automotive, public transport and healthcare
	8 (06/2018)	Commercial lawyer and intellectual property counsellor providing advice to government agencies, multinational corporations and SMEs, and routinely lecturing on IP at various universities and professional associations, with over 20 years of experience	6 (04/2018)	Roadmapping session with CEO, CTO, IP manager, VP device development; the company is small sized and focused on flexible integrated circuits.
	9 (06/2018)	Director at an independent technical consulting firm specializing in matters relating to IP. Previously worked as a consultant at a large technology consulting firm. Worked as a collaborator with on this project, and provided advice through periodical meetings.	7 (06/2018)	Hypothetical roadmapping session with Head of IP and 5 patent attorneys; the company was a large conglomerate company and focused on the areas of electrification, automation and so on.
	10 (06/2018)	Independent management consultant working with IP for over 30 years and have experience in all major aspects of IP.	8 (06/2018)	STIM training workshop using hypothetical case for 14 attendees from 8 companies.

TABLE III-B
INTERVIEWS AND IN-COMPANY CASES FOR THE TESTING AND REFINEMENT STAGE

	Interviews		Case Studies	
	Practitioner/ Case company	Profile	Practitioner/ Case company	Profile
Iteration Cycle 3	11,12,13 (04/2019)	Senior Managers, participating in STIM 2018; the workshop was designed for STIM companies who were interested in IP management.	9 (09/2018)	Parallel roadmapping session with two start-ups in Bradfield Centre- Attendees including CEO and Director of a software company; CEO and Manager of a medical technology company
	14,15,16,17 (04/2019)	Principle Research Associate at a research Center for technology management; Product Manager, Senior Industrial Fellow Solution and Development Specialist. All were experts in roadmapping from both academic and practical perspectives.	10 (10/2018)	Roadmapping session with 4 attendants from IP department; the company was Japan-based large company with a subsidiary in Budapest and provided electric and electronics equipment
			11 (12/2018)	Two groups parallel roadmapping session with 6 project leaders and 2 consultants from three product teams; the research organization was large sized and UK-based, and provided NDT, welding and inspection services.
			12 (02/2019)	Roadmapping sessions with 15 attendees of NTNU executive education program.
			13 (03/2019)	Parallel roadmapping session with three start-ups in Bradfield Centre. Attendees including 5 founders (one of an energy storage battery company, one of an induction machine drive company, and two of a 3D model design company).
			14 (04/2019)	Roadmapping session with Innovation Manager, R&D Engineer, Projects and Operations Manager, Technologist and Patent Attorney; the company was medium sized and focused on sensing technologies.

¹ Acknowledgments: to be added