Myllyoja *et al.*
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Strengthening futures-oriented agenda for building innovation ecosystems

Jouko Myllyoja*, Nina Rilla and Maria Lima-Toivanen

Abstract

This article locates itself at the interface of the innovation ecosystem approach and foresight methodologies. The need for writing this paper emerged from the notion that despite existing common praxis, there is a lack of academic studies combining these approaches simultaneously in a more profound sense. The study adapts the perspective of how foresight can assist in the development of innovation ecosystems. As a constructive study, the aim is to foster revealing the potential that foresight can have for the innovation ecosystem development in both theoretical and practical sense. Foresight approach and its methods offer anticipatory mindset and practical tools for developing and steering of ecosystem life cycle, keeping in mind that an ecosystem is not static but evolving system. For the foresight, the relevance of this article emerges from emphasising the viewpoint of stakeholders, which may generate wider and more engaged involvement of different stakeholders in foresight processes. As an outcome, the paper presents a model called the foresight wheel, which consists of three interrelated elements of 'Thinking beyond immediate cooperating', 'Enabling continuous futures dialogue' and 'Building ecosystem futures' capabilities'. The empirical reflection of this paper relies on observations achieved in an H2020-funded research project, in which both innovation ecosystems and foresight frameworks were applied as part of cybersecurity workshops organised in three Asian countries.

Keywords: Innovation ecosystem, Capabilities, National foresight, Deliberative foresight, Vision building, Futures literacy

Introduction

Foresight and innovation ecosystem approaches have increasingly been applied simultaneously in the praxis of several projects that examine technological and sectoral development [1–3]. Despite this kind of hybrid movement and emerging mutual practice, there appears to be a lack of modelling that constructs both approaches' methodological grounds in a deeper sense. This lack persists despite the references capturing the potential that foresight can have towards innovation ecosystem development [4–6]. Foresight approach and its methods offer anticipatory mindset and practical tools for developing and steering of ecosystem life cycle emphasising that ecosystem is not static but evolving system. In other words, the relationship between foresight and innovation ecosystem is acknowledged as important, but an interlinking ground is not yet opened practically or methodologically.

The School of International Futures (SOIF) [7] presents the concept of foresight ecosystem, in which foresight serves longer-term national and governmental decision-making. In the analysis conducted by SOIF [7], the foresight ecosystem can enhance more coordinated collaboration between different actors. Karjalainen and Heinonen [8] in turn present the construct of deliberative foresight, which consists of three main components — innovation ecosystems thinking, transformative potential and sustainability. By integrating these views, deliberative foresight establishes a basis for wider benefit sharing, increased innovativeness and transformability, for instance. In addition, Pombo-Juárez et al. [6] have constructed a layered view for combining foresight and innovation ecosystem approaches. They propose that

*Correspondence: jouko.myllyoja@vtt.fi
VTT Technical Research Centre of Finland, 02044 Espoo, Finland

the impacts of foresight will increase if foresight activities and outputs can be concerted better across layers of local, regional, national and international spheres.

Building an upgraded methodological agenda for the innovation ecosystem approach by integrating foresight and innovation ecosystem approaches is not a straightforward task. Rather, it can be considered as observing interconnections between wide theoretical and practical entities. As such, this article could be described as abductive theory building, emerging from our positions as researchers aided with methodological case reflections [9]. There, a theoretical framework and practical observations intertwine and develop simultaneously.

In 'Reviewing contributing approaches within foresight' section, we analyse two existing foresight approaches that integrate foresight and innovation ecosystems. This analysis concerns the deliberative foresight proposed by Karjalainen and Heinonen [8] and the multi-layered view presented by Pombo-Juárez et al. [6]. We approach these constructs by identifying existing structures and themes between foresight and innovation ecosystem modelling.

In the 'Methodological needs emerging from innovation ecosystem literature' section, we review the innovation ecosystem literature by revealing potential theoretical lenses, where foresight could support the development of innovation ecosystem thinking more proficiently. As an outcome, this chapter provides futures-oriented viewpoints to subtopics of a system of relationships. Particularly, these insights cover the interaction of an ecosystem with macro-forces, co-creating values and goals, and the conceptualisation of the innovation ecosystem.

In the 'Observations from YAKSHA workshops' section, we look at the workshop practices applied in the YAKSHA — the 'Cybersecurity Awareness and Knowledge Systemic High-level' project [2]. The section contributes to the analysis in two ways. First, we describe frameworks that were designed for the workshops, given that the objective of this paper is to demonstrate methodological praxis between the foresight and innovation ecosystem approaches. Secondly, we observe challenges and possibilities that emerged as part of organising, executing and putting together findings of this kind of workshop method. We are not handling the acquired data in an analytical or statistical manner, but instead, we are making general observations regarding workshop contents from the viewpoint of the knowledge creation process.

The findings of the paper are presented in the form of a foresight wheel model. The model consists of three sub-entities that we propose as mutual, thematic spheres that foster a futures orientation of innovation ecosystem development. These schemas of the foresight wheel are the following: 'Strengthening dialogue, futures knowledge creation and articulated value', 'Thinking beyond immediate cooperating, 'Enabling continuous futures dialogue' and 'Building ecosystem futures' capabilities'.

The foresight wheel is a practical and theoretical tool that helps on the one hand decision-makers working in ecosystem settings by giving concrete ideas how the ecosystem partners can be involved in the foresight process that strengthen anticipatory capabilities within the ecosystem. On the other hand, the foresight wheel is a useful tool for managing projects that focus on setting up or developing existing ecosystems.

Reviewing contributing approaches within foresight

In the following section, we review two existing approaches that contain an integrative interface between innovation ecosystems thinking and foresight. We approach deliberative foresight and multi-layered approaches with the aim to identify existing theoretical structures between foresight and innovation ecosystems. As pointed out earlier, there are not that many methodological attempts in this interface yet, which has also led us to approach these existing approaches in an instrumental way. We also briefly reflect observations of the review towards general facets of foresight — knowledge, relations and capabilities [10].

Deliberative view

Karjalainen and Heinonen [8] combine foresight and ecosystem modelling in a form of deliberative foresight. Emerging from the developing country context, deliberative foresight consists of three components: innovation ecosystems thinking, transformative potential and sustainability. By integrating these views, deliberative foresight aims to achieve more lasting, sustainable changes in society. According to the authors [8], it may lead to broader benefit sharing, increased innovativeness and transformability, potentiated ownership and improved value creation and retention. From the deliberative view, we capture two elements: the participatory nature of foresight and the building of transformability.

Since the 1990s, the participatory nature of the foresight process has been strengthened [11]. It has meant wider involvement of experts, citizens and other stakeholders in foresight processes [12]. Ideally, the foresight process has a strong interactive nature, where participation takes place from the very beginning of the process [8]. For innovation ecosystem development, participatory methods of foresight propose an opportunity where the futures of an ecosystem are constructed in a collective sense which, on its behalf, can increase the commitment of stakeholders to the continuity of collaboration. The participatory nature of foresight may

also inform decision-making processes, assist in coordinating agents and policies or build shared actions towards defined vision [13], in other words, support the transformability of foresight in different means and levels.

In the methodological context of our paper, a key issue in participation builds on assuring interaction between stakeholders. In particular, a transition away from technical and expert-driven foresight towards societal scoping has increased interest in understanding interaction across disciplinary boundaries [14]. In this regard, futures methods should pay particular attention to the interactivity of foresight, in which multiple perspectives meet and understand each other proficiently. Interactivity is increasingly important in today's environment, which is characterised by uncertainty and complexity, where 'the growing interferences and pace of changes are increasing the necessity for new forms of knowledge in order to underpin policy change and innovation ([15], 17). Applying interactive and participative methods systematically can have an essential role as a promoter of cross-disciplinary knowledge exchange and learning [13].

Regarding the transformability of foresight, Karjalainen and Heinonen [8] refer to the foresight's ability to stimulate debate on more radical, or wider, futures and to map their usefulness for different stakeholders. For stakeholders, extended future views realise in the foresight's capability to make a range of strategic options observable [16]. In this sense, building methodological interconnections between foresight and innovation ecosystems come close to qualities of strategic foresight, which represents a fusion of futures methods and strategic management [17]. Besides mapping the futures, the strategic foresight translates foresight findings into action; in other words, it makes the planning of the futures tangible [18]. Transformation of intangible views to tangible actions demands attention. We argue that even more attention is needed in the ecosystem context, given its dependency on common value creation [19], which is a highly intangible construct but needs to be translated into system-level processes.

For the use of innovation ecosystem development, the above considerations highlight the possibilities that relate to the participatory and transformative nature of foresight. There, from the perspective of three facets of foresight — knowledge, relations and capabilities [10] — we can conclude that foresight can support innovation ecosystem development through the following mechanisms or activities in particular: creating a shared understanding of potential future developments (knowledge), participating with stakeholders in joint visioning (knowledge, relations) and increasing the tangibility of required future resources and skill sets to achieve mutual goals (knowledge, capabilities).

Horizontal and vertical dimensions of foresight

Pombo-Juárez et al. [6] have approached the interlinkages of the foresight and the ecosystem through a multi-layered approach. From their work, we capture horizontal and vertical dimensions of foresight for the use of our constructive modelling [20]. In the ecosystem context, these dimensions can be considered an ability of foresight to create collective understanding and knowledge from different aspects and for different purposes.

When looking at the horizontal aspects of foresight, it can be described as supporting operations across different disciplines and areas of research, enabling cooperation and making mutual prioritisations [14, 21]. In the health sector, for example, horizontal development may consist of participation of variety of patient groups, clinical specialities, different technology fields and health services [6]. There, Havas [22] highlights that the added value of foresight is likely to increase only when it overcomes any potential sectoral and disciplinary barriers.

The vertical aspects of foresight can be approached from the viewpoint of foresight impacts which, according to Pombo-Juárez et al. [6], will increase if foresight activities and outputs can be concerted better across layers of local, regional, national and international spheres. At the same time, the involvement of actors from different levels establishes a platform for knowledge creation that consists of a variety of scopes and strategic lenses. Besides the verticality in knowledge creation, multilevel participation serves decision-making, taking place at different levels of an innovation system [22].

Together, horizontal and vertical spinning can be considered a networked foresight, where foresight is executed in innovation networks for the benefit of stakeholders [23]. In the innovation networks, the foresight can restructure relations, enhance knowledge processing and incubate learning and joint actions [10]. Similarly, Amanatidou [24] regards foresight as a network building or co-production process that can enable the emergence of new transaction, dialogue, negotiation and cooperation between the stakeholders.

From the viewpoint of foresight facets [10], we can conclude that both horizontal and vertical dimensions propose the possibility to create multi-perspective knowledge that can be beneficial for participatory organisations both individually and collectively. From a relations perspective, we can acknowledge particularly that the foresight process can make different future cooperation forms perceptible. From the capability building perspective, we may highlight that the foresight process may assist in identifying complementary — existing and forthcoming — resources between stakeholders.

Methodological needs emerging from innovation ecosystem literature

While foresight literature and roadmap practices have their roots in dynamic capabilities [25] and absorptive capacity [26] traditions, the ecosystem literature is based on the innovation system and clustering literatures, for example [27, 28]. A common denominator for both constructs is that they are the subject of interest of strategy scholars. Essentially, the ecosystem literature emphasises collaborative relationships and knowledge sharing as important concepts of business and management studies. The ecosystem is a fairly new concept, and therefore, it creates conceptual ambiguity for ecosystem research, given its resemblance to other closely related concepts such as interorganisational networks, clusters, geographical regions or platforms [27]. The research is further challenged by the empirical ambiguity, given that the ecosystem often integrates concepts of different ecosystems, such as a knowledge ecosystem, a technology ecosystem and a business ecosystem being integrated to an innovation ecosystem, as they help to obtain and create value for the knowledge created [29, 30] — for variation in ecosystems, see also Jacobides et al. [31]. Another challenge for research is that the ecosystem is introduced as a concept that intentionally neglects human agency [30], which complicates the identification of the actor but forces us to concentrate on processes.

The above ambiguities raise critical debates on the ecosystem concept, and Oh et al. [32], for instance, argue that the concept of innovation ecosystems does not bring anything new to the discussion about innovation systems, as it is factually used to refer to innovation systems. Regardless of the lack of consensus in the literature, the ecosystem concept has become an increasingly prominent tool in an innovation-driven growth policy, since it promotes not only traditional cooperation but also co-creation, which is seen as key to innovation both in private and public spheres. In growth policy thinking, the innovation ecosystems widen innovation activity from sectoral silos and promote cross-sectoral and cross-regional dialogues. In this study, we choose to follow the innovation ecosystem literature in combination with the value co-creation [19, 33, 34] concept, as they offer a holistic view of the diverse interacting elements needed for knowledge exchange in an emerging ecosystem, which is, in addition, in need of forming a common vision with stakeholders, urging cross-sectoral knowledge and technological complementarities for novel solutions and engaging citizens to improve awareness, recognition and acceptability.

Here, an innovation is seen as the result of a complex process of interactions between a dynamic configuration of knowledge and stakeholders. For instance, complex societal challenges, such as extending cybersecurity beyond national borders, demand systemic innovations which need attention from several stakeholders and collaboration between private and public actors.

Innovations are produced through a complex and continuously evolving system of relationships involving state, academia, industry and civil society [35]. Given the systemic view on innovation, in this study, the innovation ecosystem is understood as a complex system that aims to generate new knowledge combinations, i.e. innovation [19]. While business ecosystems focus on value capture, innovation ecosystems concentrate instead on shared value creation [36, 37].

Many innovation ecosystems, especially in the emerging phase, are highly dependent on processes in the macro environment, e.g. regulatory frameworks [38, 39] that shape cognitive frameworks, like a common vision and legitimacy [40, 41]. Processes such as value creation and knowledge exchange are at the core of the innovation ecosystem approach. Although innovation activity also takes place outside ecosystems, the basis of ecosystem thinking is that bringing actors who previously acted in their own sectors and silos together will accumulate shared value and knowledge and make innovation more probable and sustainable. Furthermore, it is important to acknowledge in the innovation ecosystem context that innovations are not only disruptive and radical market-changing technologies [42], but the ecosystemic way of working also produces solutions and incremental innovations in both the product and the service domains. Overall, innovation is seen to extend beyond technological aspects, making the innovation ecosystem embedded in the knowledge society and addressing socio-technical change to better realise the non-technological components of building future ecosystem capabilities.

Developing sustainable solutions aiming to meet grand challenges depends on complex interactions between different ecosystem actors. However, achieving sustainability in innovation does not merely happen inside the ecosystem. It demands reflexivity in terms of actors' motivation, and especially wider inclusiveness of stakeholder and citizen interests, values and perspectives [43]. Therefore, one of the central processes in ecosystem building is value co-creation that stresses joint and collaborative formulation of new value — not only material but also symbolical [33]. It is evident that organisational strategies and capabilities are shifting from actor-centric systems to ecosystems, in order to capture the benefits of shared value as proposed by Kramer and Pfitzer [44]. The concept of shared value combines competitiveness with social and economic sustainability [45].

For the knowledge exchange to take place, the innovation ecosystem needs to develop motivation among mutually dependent actors. The creation of shared value

[44, 45] is a key motivating factor, but value is a complex multidimensional and multilevel phenomenon [46] that makes it difficult to capture. The roots of value co-creation are in-service sciences and have traditionally emphasised customer involvement in service design [47], but ideas have recently been extended to the system level [19, 34, 44]. Even though shared value forms on interdependencies between the repetitive sequences of cooperation, conflict and compromise [48], the alignment of value is not always possible or even desirable among stakeholders [49]. The value co-creation process can also result in a neutral solution or simply take a long time to form. Furthermore, neither the ecosystem nor the shared value is static, but both are continuously evolving, which makes value challenging to capture, not least because the innovation ecosystem stakeholders form both collaborative and competitive interdependencies. Actors coevolve and co-adapt within the ecosystem.

Development of ecosystem capabilities

Eventually, it is hoped that the co-creation of values and goals in the ecosystem will form ecosystem-level capabilities. The capabilities develop through routines and processes, stressing the repetitive pattern of activities [50, 51]. In the ecosystem context, capability can be understood as an ecosystem's capacity to deploy and combine tangible and intangible resources, using organisational processes, to effect a desired end [52]. Given that tangible assets tend to depreciate over time, while intangible assets may accumulate value over time [53], it is essential that actors learn to operate together in order to accumulate ecosystem-level capabilities that form tangible and intangible assets of information, knowledge and experiences that appear in skills, processes and routines [54].

Helfat and Peteraf [50] have proposed a concept of capability life cycle, proving us that capabilities evolve as part of a process, and suggest that they can extend outside one organisation or sector of origin. The latter perspective is often neglected in resource-based approaches, although it suits ecosystem-level investigations that essentially examine various resource (including knowledge) constellations.

Since capabilities are traditionally understood to be organisation (or firm) specific, the literature on capabilities in other contexts, like ecosystems, is not yet extensive. A couple of recent exceptions exist that investigate innovation ecosystems' operations from a capability, namely dynamic capability [25], perspective. For instance, a study by Linde et al. [55] investigate how capabilities evolve to develop ecosystem innovations in a smart city context. They adopt an ecosystem orchestrating perspective that looks at how ecosystem leaders develop and use dynamic capabilities to foster innovation in the ecosystem. Orchestrating an ecosystem demands not only vision but also dynamic skills to manage value creation and innovation partnerships, for example. Linde et al. [55], however, show that capabilities need to interact with other capabilities for the ecosystem, as prioritisation of one capability over the other does not result in sustainable outcomes. Similar results are shown in the study by Lütjen et al. [56], which indicates that innovation-intensive firms possess stronger ecosystem-related capabilities than less innovative firms, and they have a wider scope of relationships with stakeholders. An additional ecosystem level perspective is given in a longitudinal study of value co-creation that highlights how technological capability as one dimension of value co-creation process gradually intensifies reciprocity as the technology-intensive ecosystem matures [57]. These findings are thus from a service innovation and platform contexts, which emphasise well how innovation often requires relationships with all the ecosystem actors and how these relationships are likely to evolve over the ecosystem life cycle.

In fact, adopting a capability perspective reveals ecosystem-level processes, which are a key dimension for understanding ecosystem emergence, evolvement and dynamics [30]. We argue that one of the central capabilities for ecosystem emergence and subsequent sustainability is a foresight capability — an ability to build common values and a vision of the future that also works as a mechanism to engage all ecosystem stakeholders: both value adding and not directly value-adding actors (e.g. regulatory institutions, civil society actors).

Observations from YAKSHA workshops

The YAKSHA project — Cybersecurity Awareness and Knowledge Systemic High-level Application — was funded under the European Union's Horizon 2020 research and innovation programme. The overall aim of the project was to reinforce cooperation between the European Union and the Association of Southeast Asian Nations. The project aimed to build partnerships in the cybersecurity domain by developing solutions for specific users and national needs, leveraging the EU's know-how and expertise.

As part of defining a state-of-the-art and future cybersecurity ecosystem for the deployment of cybersecurity software, the project organised co-creation workshops in Malaysia, Thailand and Vietnam involving multiple stakeholders [2]. The aim of these workshops was to bring together different cybersecurity stakeholders to create new grounds for future collaboration in regional, national and international contexts, to contribute to national decision-making and to create shared understanding and share knowledge about cybersecurity in their national contexts.

We designed two frameworks (Figs. 1 and 2) that contain elements from both foresight [58] and innovation ecosystem modelling [59, 60]. The workshops started with the task of vision building (Fig. 1). Besides futures orientation, this framework relied vaguely on quadruple helix modelling [60], in which key actors are typologised

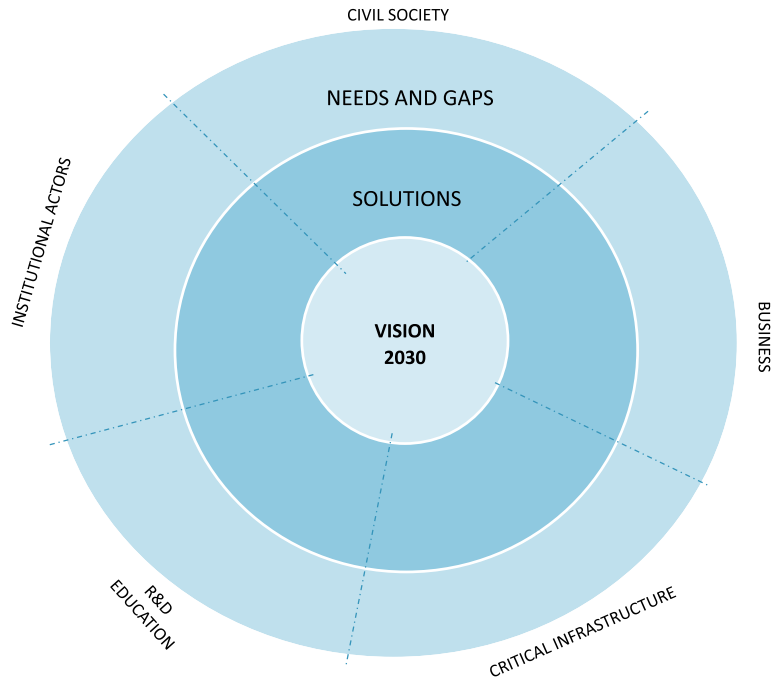

Fig. 1 The framework for vision building

KEY ACTION ROADMAP	SHORT-TERM 2020	MEDIUM-TERM 2025	LONG TERM 2030	
ACTIONS	*Key action items to respond needs or gaps of a system*			VISION
ACTORS	*Identifying key actor groups or individual organisations that can enable the systemic change to occur*			
IMPACTS	*Identifying impacts / implications / outcomes of actions by actors*			

Fig. 2 The framework for building key action roadmap

under government, academia, industry and civil society. To better suit the cybersecurity context, the stakeholder typology was modified to cover civil society, business, critical infrastructure operators, research and development (R&D), knowledge and education and institutional actors. Government was transferred to cover many kinds of institutional actors, and academia was expressed as 'R&D and education'. In addition, we wanted to address one specific domain related to cybersecurity, and we established an additional thematic sector called 'critical infrastructure'.

The participants were divided into five subgroups according to their stakeholder status. Each group focused primarily on creating content for their sector of the framework, but groups were encouraged to provide views on other sectors as well. Looking at the outer circle of the framework, needs and gaps referred to relevant, emerging issues that should be addressed nationally during the forthcoming decade, while the solutions circle was related to responses or activities that should be made in relation to identified gaps and needs. All contents served as a source for vision building, whereas each group created a vision version from their point of view. Practically, groups were asked to create contents to 'needs and gaps' and 'solutions' layers first. Then, they were advised to crystallise their observations into a form of a national vision. This version of a vision also worked as a starting point for a second framework in which the same groups continued their work by creating action paths towards the desired state of the future.

The second framework (Fig. 2) was working as a tool to identify essential actions that should be taken in the short, medium and long term towards the vision defined previously. As part of this task, future actors and impacts were also identified. The actors referred primarily to stakeholders that would take place as executors of planned actions, but they could also refer to actor groups who were not active change-makers but whose realities might be affected by the planned actions. Impacts refer here to a wide range of technological, social and environmental impacts that could be achieved or that follow the implemented actions.

Table 1 presents an aggregate summary of the data of status, needs and envisaged actions of cybersecurity ecosystem acquired through different national workshops. These aims and actions are reflected in the cybersecurity visions produced in the workshops and reveal how similar improvements are needed in all the target countries — Malaysia, Thailand and Vietnam. These observations have created the basis for recommendations of a deliverable focused on a foresight process conducted as part of YAKSHA [2].

As a part of our methodological build-up, we approach the above contents in a generic sense. In particular, by adopting a stakeholder view, we can observe that cybersecurity attaches closely to building a safe and resilient society. There, it is essential to consider the role of governance and policy and to build more solid ties with civic society. As an example of an overarching societal phenomenon, cybersecurity requires a new set of structures and activities, where citizens are taking part as an important group of learners and change-makers [61]. From the viewpoint of developing national innovation capabilities, our main observation concerns organising innovation activities in a systemic way. From the stakeholder point of view, it concerns the existence of a coordination

Table 1 The four domains for developing the cybersecurity innovation ecosystem

Domains	Aims	Action items
Regulation and governance	Towards a cybersecurity-resilient society	To have up-to-date policies, to support business development, to recognise the interdependencies among societies and the risks of cyber threats, and to strengthen international cooperation and knowledge exchange
Awareness and education	Improved public awareness of cybersecurity issues at all levels of society	To recognise the role of individuals in the cybersecurity ecosystem, and to design strategies and action plans for improving cyber resilience at different levels and in different spheres
Innovation capabilities	Improved prerequisites for open collaboration and co-creation between partners	To invest in cybersecurity start-ups and provide platforms (e.g. incubators, hubs), where R&D&I are driven in strong industry-academia collaboration, and to exploit public-private partnerships and procurement in advancing innovative solutions and businesses
Strategic development of technologies and businesses	Sharing futures orientation in addressing societal needs	To establish novel coordinating organs such as national cybersecurity centres or virtual hubs, to share understanding on the adoption of technologies in strategic planning both at the national and international levels, and to develop stakeholder dialogue

organism, integrating national ambitions of competence development of different stakeholders and particularly by enabling open knowledge sharing between stakeholders. To summarize, developing a cybersecurity ecosystem in ASEAN context demand in particular activities to engage different stakeholders, i.e. clarify roles and build relationships and partnerships.

Results

We have explored how foresight can enhance understanding and development of innovative ecosystems. The findings of this work are crystallised below by presenting a model called a foresight wheel for innovation ecosystem (see Fig. 3). This model consists of three dynamic elements: 'Thinking beyond immediate cooperating', 'Enabling continuous futures dialogue' and 'Building ecosystem futures' capabilities'. All three elements should be interpreted as interlinked schemas. The fundamental idea is that these three dynamic elements make up how foresight can contribute to innovation ecosystem development. Alongside these three core elements, the model contains a vision in the middle and landscape dimension in the outer layer. Vision captures an idea of compiling shared intentions between different stakeholders of the innovation ecosystem. Landscape refers to changes of an exogenous environment that may cover drivers, megatrends or other development curves occurring in a society [62]. The core elements of the model are seen to take place within these larger and longer-term landscape developments.

Potentially, the model is usable in different contexts, where development sphere desires strengthened futures orientation across traditional operational boundaries or existing mindsets. These needs may concern (re) structuring of a national level innovation programmes or development of regional cooperation to advance a multi-actor way of operation. The model can also have some organisation level management implications, for example with a research organisation that is managing a long-term project that focus on setting up or developing existing ecosystems and demand involvement of variety of stakeholders. In addition, for future research, the model attempts to open the way for novel constructs elaborating the interface between foresight and innovation ecosystems.

Thinking beyond immediate cooperating

Strengthening the futures orientation of innovation ecosystems concerns identifying and bringing potential stakeholders together and increasing the futures

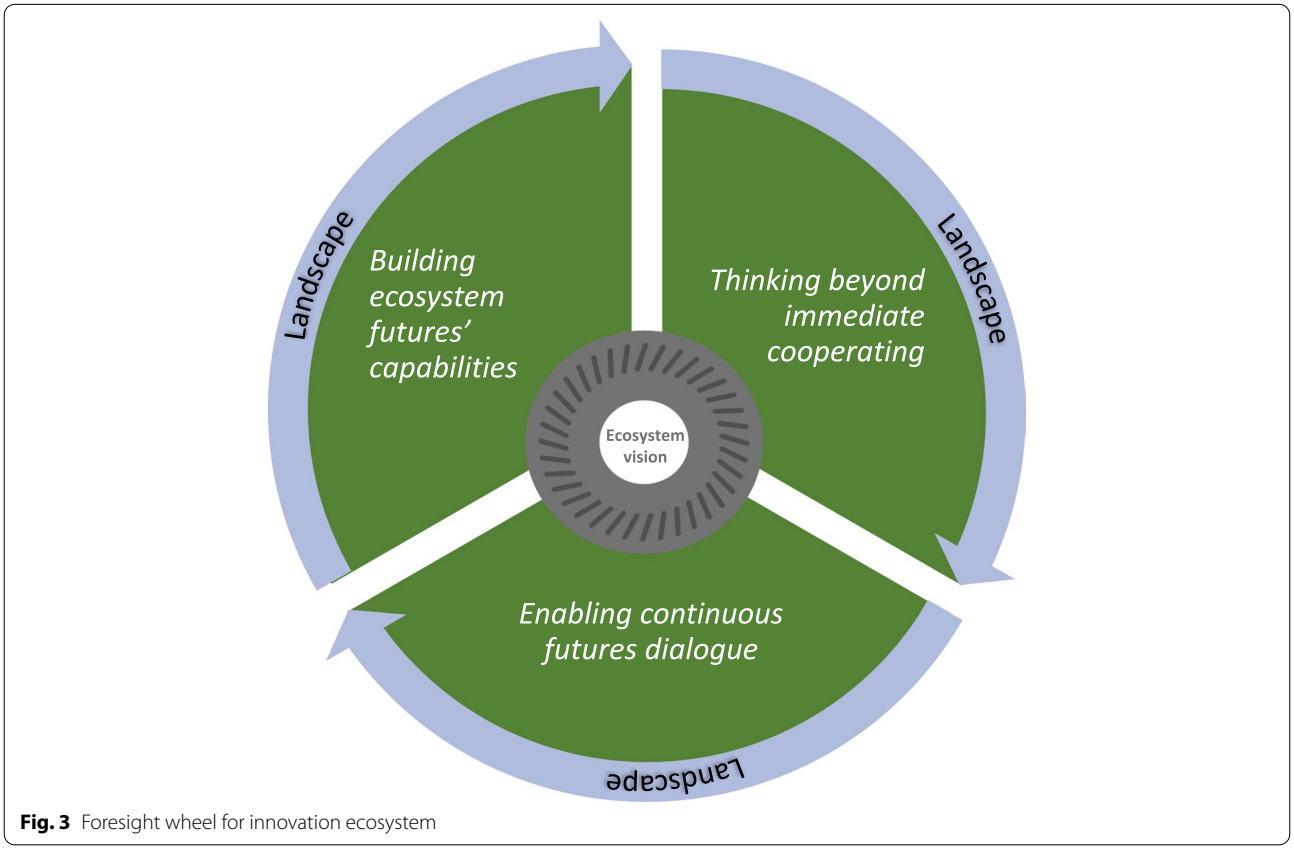

Fig. 3 Foresight wheel for innovation ecosystem

orientation of the cooperating organism. Possibilities concerning enhanced foresight activities relate to finding solutions for emerging schemas among stakeholders [22]. Ideally, the foresight process attempts to involve all relevant — existing and future — stakeholders to ensure contextual coverage and richness of future images.

Our study embraces possibilities that relate to stakeholders' involvement in a wide sense. These extending opportunities can be divided into horizontal and vertical considerations. The horizontal dimension is understood here as participation by actors who share a similar view of the aims and values of the innovation ecosystem, while the vertical dimension refers to a need to strengthen the presence of layered reflection in implementing foresight in different spatial scopes of innovation (local, national, international). By adapting these views together, we propose that ecosystem development would benefit from more comprehensive *multidimensional thinking* in both vertical and horizontal directions, where contents are created and reflected in various scopes. This approach builds on the foresight capability to create perspectives [63] that could lead to increased *quality of perspectives* of the foresight. In the innovation ecosystem context, we define the quality of perspectives as a presence of quality and quantity of stakeholder participation in the foresight process.

Building innovation ecosystems could benefit from having a stronger grasp on more distant and vague futures. By detaching from incremental thinking and creating compositions of actors for a variety of future possibilities, innovation ecosystems are looking collectively for more disruptive opportunities and are also likely to increase their collective responsiveness and resilience to future challenges.

Enabling continuous futures dialogue

Foresight is not ideally something that is conducted only by means of a singular project. To improve the responsiveness of any organ towards increasing complexity and constantly changing needs, foresight should be able to incubate futures knowledge and shared understanding on a continuous basis [63, 64]. The innovation ecosystem, as a multidisciplinary and multi-stakeholder endeavour, offers favourable ground for futures dialogue in which different perspectives meet and create multidimensional responses to emerging needs.

In this respect, the foresight represents a wide set of methods to produce futures knowledge and to design the futures-oriented activities of an ecosystem. Regarding the applied methods, flexibility and interactivity are specific characteristics that are needed to engage diverse audiences and enable a cross-disciplinary exchange of knowledge [13]. In fact, the foresight capability to facilitate interaction between stakeholders strengthens the creation of a collective knowledge base and supports decision-making that aims for longer-term futures [65].

The stakeholders hold a variety of expectations that develop and change continuously and often even rapidly due to changes in the regulatory or innovation environment. For example, sudden shocks like a cybersecurity attack may change the national focus and change the dynamics of an innovation ecosystem either temporarily or permanently. To make these views more observable through different formal and non-formal ways of communication, the foresight process improves actors', like the innovation ecosystem's, capabilities to support engagement, achieve the desired impacts and create a basis for further collaboration through co-created value [45].

Futures need to be built and articulated commonly and continuously. In a national context, this process can be supported by building structural ties to research programmes, strategy building processes and political decision-making. An additional aspect to underline is that besides building on the understanding of futures by means of structured methods and approaches among different domains and spheres, futures are approached in everyday interactions [15]. Theoretically, we may here refer to futures literacy [66, 67] — considering foresight as a societal capability or as a mental futures orientation in thinking and making.

Building an ecosystem's futures capabilities

The standalone practice of foresight by the ecosystem stakeholders, let alone foresight exercises in one single stakeholder organisation, does not create a capability. The capabilities accumulate through shared values and routines that in the ecosystem context require collaboration and co-creation among ecosystem stakeholders. We can also underline the significance of collaborative learning capabilities of all parties [68].

As the literature [50] suggests, the capabilities do not exist in a newly established ecosystem — instead they need to be formed in a co-creative process with the ecosystem actors. The development of ecosystem-level capabilities is an even longer process in an emerging ecosystem setting, like our case example of ASEAN cybersecurity ecosystem, in which the actors have not yet built routines to work together and a shared value creation process has just started to develop.

Foresight as a strategic action or tool demands repetition before it transforms into ecosystem-level foresight, or futures, capability. This notion of repetition is emphasised in the cyclical process of the foresight wheel, noting the importance of futures' dialogues among the ecosystem stakeholders.

We argue that an ecosystem's futures capability is important for its sustainability, given that the operational capability of implementing foresight can translate into the ecosystem-level dynamic capability, which enables the ecosystem to build competencies and resilience to adapt to change that is evident in a fast-changing environment, like cybersecurity.

Vision

We emphasise the significance of making future potentials perceptible, which simultaneously binds different stakeholders together. By adapting the viewpoint of value creation addition, different stakeholders expect to locate themselves as part of a contextual and operational entity and to see the benefits that they can achieve through the collaboration. To achieve the stage at which the stakeholders can position themselves in this futures-oriented network of actors, it is required to create a shared understanding of the aims and potential directions of collaboration. The vision, understood as an articulated description of a future state of affairs that an individual or group finds desirable [69], offers a wide frame for consolidating mutual desires [70]. It can be understood as a shared, upper-level schema that all participating actors can devote themselves to and engage with. Besides the devotion, one essential motivation for formulating visions is that they underpin and promote change [58], wherein visions are also likely to create commitment to identified actions. In summary, foresight offers an approach to address innovation ecosystem dynamics by strengthening anticipatory mindset needed in developing and steering of continuously evolving complex system. Given that the innovation ecosystems benefit foresight, also foresight can benefit of innovation ecosystems as a platform for collective sense-making of futures. Foresight capability and futures literacy develop in a complex system of interactions between actors. Therefore, we argue that it is highly beneficial to understand complexity of ecosystems for high-quality foresight, while it is beneficial to adopt foresight mindset for proficient steering of the innovation ecosystem.

Discussion

The link between foresight and innovation constructs one fundamental nature of foresight. Despite that this relationship can even be taken as self-evident, it is far from being straightforward [8]. At a policy-level only, we can observe the complexity of the interwovenness of foresight and its promises in supporting innovation policy building and execution at many levels and in many forms [71]. In our attempt to increase our understanding of interrelations between foresight and innovation ecosystems, it can be described as an equally challenging task. Based on our expertise and experiences in the field, we can however conclude that they share many mutual orientations. We suggest that both foresight and innovation ecosystems share a methodological interface in that they approach innovation creation from a holistic perspective, model complexities, create an understanding of innovation dynamics, are interested in identifying and engaging stakeholders, and establish a wide frame for building recommendations, actions and strategies to support innovation.

Futures need to be built and articulated commonly and continuously. A futures literacy or the narrativity of foresight of the innovation ecosystems is needed to build resilience in today's rapidly changing environment, which is characterised by grand societal challenges demanding urgent solutions. Understanding the future may translate as ecosystem-level foresight, or futures capability, if systematically practised in the ecosystem. As a result, we would have more resilient and sustainable innovation ecosystems that contribute to the national research and innovation environment beyond a specific funding period.

Regarding the continuity of foresight, there is a threat or even a tendency that foresight activities may remain project based as a sporadic activity and do not translate into futures capabilities. To improve the transformability of foresight, the advancing of its integration into existing structures of the innovation system plays a pivotal role. In concrete terms, the integration may concern identifying national research programmes or organisations that are motivated to learn and to adapt foresight methods more solidly in their activities and promote the possibilities of the foresight in these organisms. In this sense, international research projects that contain foresight can also be seen as platforms to promote foresight methodologies and their usefulness in new development environments.

Lastly, we highlight the significance of differences in innovation cultures that can have effects on conducting an international foresight process. Some innovation cultures share a stronger top-down approach, where innovation is seen as an incremental activity. Such a top-down approach can be quite contrary to some other innovation environments, where distant futures are approached more conveniently with disruptive ways of thinking and creativity adapting creativity working methods. As a general reflection, our experiences have shown that the international foresight processes should pay particular attention to adequate duration, dialogue, openness and flexibility in design and execution. In this way, the foresight attaches more closely to prevailing cultural grounds of innovation and improves its possibilities to contribute to changes.

Limitations

The foresight wheel model presents a methodological construct that responds to the question of how foresight can support innovation ecosystems development both methodologically and practically. Developing this model can be described as a process that has consisted of putting together many interrelated theorical strands and practical observations. For the future, there are many interrelated theories that could deepen the understanding.

Even though we used the case of the ASEAN cybersecurity ecosystem as a descriptive example in this paper, one of the limitations of this paper is that we are not able to verify how the futures capabilities have in fact developed in the innovation ecosystem. However, this deficiency leaves room for further research to collect retrospective data from the same case context to learn more about the ecosystem's evolvement.

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Authors' contributions
JM made the overall structure for the paper and contributed from the foresight perspective in particular. NR was primarily responsible for creating contents from the perspective of innovation ecosystem literature. ML was responsible for the original workshopping data reporting and reviewed this article in its later stages. The authors read and approved the final manuscript.

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