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European Journal of Futures Research (2025) 13:14
https://doi.org/10.1186/s40309-025-00252-w

European Journal
of Futures Research

RESEARCH ARTICLE

Open Access

Developing the Futures Map Framework – an integrative hybrid foresight approach

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Abstract

Futures research typically involves the utilization of multiple methods, referred to as hybrid methods, to reach a particular objective. In this paper, the earlier Futures Map concept is developed into the Futures Map Framework (FMF), a hybrid foresight approach that operationalizes the Futures Map concept for practical use in organizations.

The FMF Integrates alternative futures images and paths, visions, and roadmaps, and their respective methods. It addresses the limitations of these methods when used separately, leveraging their synergistic potential for more effective futures research and for more actionable futures from the perspective of those who will use the FMF. Furthermore, the key methodological choice for the framework are three time horizons related to decision making: the Past Horizon, the shorter-term Action horizon, and the longer-term Mapping horizon. The FMF suggests different roles for roadmaps and scenarios related to the Action Horizon and the Mapping Horizon, while the Past Horizon provides evidence for the other horizons. During the Action Horizon, the organization is committed to realizing the selected roadmap towards the vision. On the one hand, the Mapping Horizon scenarios open uncertainty with all its opportunities and risks for decision makers when they select the roadmap of the Action Horizon. On the other hand, the Mapping Horizon scenarios with new scenarios based on realized development are the frame for the construction of a new future roadmap that will follow and replace the roadmap of the earlier Action Horizon.

The theoretical contribution of this paper is in the interpretation of visions, scenarios, and roadmaps in a synergistic manner, introducing the distinction between the Mapping Horizon and the Action Horizon; therefore combining past, present, and future time horizons, and proposing a foresight approach for their practice-oriented integration. While acknowledging the limitations of this paper, the special focus of the paper is on enhancing the FMF's applicability for the use of real-world cases, thereby establishing its utility for futures research. Thus, we consider the paper contribute to the methodological advancement of futures research and foresight, while encouraging further research and development of integrative hybrid foresight approaches.

Keywords Futures Map, Hybrid foresight, Methodological development, Scenario planning, Scenario, Roadmapping, Roadmap, Visioning, Vision, Visionary leadership

Introduction

Futures studies is an evolving inter-, multi-, and transdisciplinary field. Nevertheless, there seems to be continuities that many in the field share. First, the notion of alternative futures and the division to possible, probable, and preferable futures [1–3], and later to many more subtypes (see, for example, [4, 5]). Second, the values futures studies serve and especially the pursuit of desirable futures [1, 2, 6–8]. Thus, we can argue, that alternative futures and pursuing desirable futures are at the core of

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futures studies. Lum [9] goes even further by reasoning that "[f]utures studies is the field for exploring the normative", asking "what should be?", and uniquely focusing on visioning and shaping preferred futures. From this point of view, futures studies have a deep connection to visionary leadership and management, i.e., for the creation and communication of clear, inspirational, and energizing visions inducing emotional responses and forming bridges between ideas and action and between people; consequently creating a sense of shared purpose and commitment motivating efforts required to realise the vision, and integrating the vision into organization's management systems and practices [10–13].

While alternative futures and visioning are central to the field and visioning being even a foundational and unique method in the field of futures studies [14, 15], there are many issues with the related concepts, theories, and methods [16–24]. Correspondingly, it is noted that there are similar issues with regards to scenarios and scenario planning, which are typically used for constructing alternatives futures, and related to roadmapping and roadmaps, which are generally used for constructing plans of action [16–24]. The shared issues include the fact that the concepts have various meanings, divergent and even conflicting definitions, principles, and characteristics, and that the methodologies and techniques for their implementation are also numerous and diverse [16–24]. Thus, it is important to be aware of the nature and characteristics of each and care for them during any instance of method utilization.

Scenario planning is considered fundamental for developing strategies under uncertainty [25], although too often there is an elementary discrepancy between the expectations regarding the scenario planning process and what the process was intended to accomplish [26]. For example, a scenario planning process might be applied with the emphasis on long-term visions without consideration for short-term decisions. That is for constructing "vision-driven scenarios" focusing on wide-ranging and large-scale drivers of change, broadness and divergence of perspectives, external expertise, generation of new ideas, and advancement of collective understanding regarding possible futures and the necessity of change [26]. As an alternative, Courtney [26], for example, proposes "decision-driven scenarios" focusing on defined uncertainties driving decisions, shorter terms, data and analytics, internal and industry expertise, and testing alternatives of a particular decision by considering the array of potential outcomes and their implications.

Another way to explore alternative futures and address the potential difficulties is to use and combine multiple futures research methods. While in practice it is quite typical in foresight exercises to use or mix different futures research methods together [27], Tapio et al. [28] have called for futures researchers and foresight practitioners to give greater consideration to these so-called "hybrid futures studies methods, i.e. methods combining several techniques". In addition to producing new information, a mindful combination of methods can, e.g., increase the reliability and appeal of the methods. Such a combination has been argued for by Myllylä and Kaivo-oja [29] in a study combining Delphi with strategic planning and decision-making tools. Furthermore, there is specific encouragement to merge components of scenario planning with those of roadmapping; the methods have found to be complementary as both have certain advantages, and the advantages of each work to counter the disadvantages related to the other [21, 30]. In addition, while many approaches require an *either-or* decision regarding the timeframe (shorter or longer term), there is the option to choose *both* integrated to one another – a need to consider multiple time horizons that, for example, have been discussed by Saritas et al. [31]. These notions have not been left unnoticed as for example Hussain et al. [21], Saritas and Aylen [30], and Strauss and Radnor [32] have developed methods combining scenario planning and roadmapping to obtain the "best of both worlds" [32].

One of the methods, which is still a rather conceptual framework integrating different time horizons with different futures research methods is the Futures Map [33, 34]. Although 'futures map' was already used as a metaphor in Finland in the 1980s and was explored in the widely referred to Finnish textbook of futures studies published in 2002 [35], it has not been extensively adopted in the field [36]. Subsequently, Malaska and Virtanen [37] presented the concept of Futures Map, which was then developed further by Kuusi, Cuhls, and Steinmüller [33, 34] into a conceptual framework. They [33] define a Futures Map as "the comprehensive description of the outcomes of a futures research process" made up of "all relevant pictures of the future identified during the process and all relations between these pictures and between them and the present state as well as assessments about time frames, desirability and possibility of these pictures.". We argue that all futures research and foresight processes construct or map futures, more or less explicitly, in one way or another. The Futures Map has the potential to combine visioning with the exploration of signals of change, strategic options, and short- and long-term decision-making, and it incorporates the fundamental perception of alternative futures (see, for example, [1, 38]) forming an integrative hybrid foresight framework. However, the Futures Map is still at a conceptual level and especially lacks pragmatic approaches for its utilization.

In this paper, the Futures Map, which was initially presented as a theoretical construct and a conceptual approach for futures research, is developed into a practical foresight approach, the Futures Map Framework (FMF). By integrating alternative futures images and paths, visions, and roadmaps, and their respective methods, the FMF addresses the limitations of these methods when used separately, leveraging their synergistic potential for more effective futures research. The special focus of the paper is on enhancing the FMF's applicability for use in real-world cases, thereby establishing its utility for futures research.

First, we examined the theoretical backgrounds of alternative futures images and paths, visions and visioning, and roadmaps and roadmapping by conducting a literature review; this review constructs a solid theoretical basis for the Futures Map Framework. Second, we developed the first version of the FMF, the accompanying pragmatic quality criteria, and a baseline foresight process for the applications of Futures Maps. Third, the application of the Futures Map Framework is then discussed through illustrative examples which consider some widely employed theories and tools and through which the FMF can also provide foresight-enabling perspectives.

The theoretical contributions of the paper are: 1) the interpretation of visions, scenarios, and roadmaps in a synergistic manner, 2) the introduction of the distinction between the Mapping Horizon and the Action Horizon, 3) the combination of past, present, and future time horizons in the Futures Map Framework, and 4) the proposition of a foresight approach for the practice-oriented integration of the aforementioned concepts. The development of the Futures Map Framework from a conceptual to an integrative hybrid foresight approach is a contribution to the methodological advancement of futures research and foresight. Overall, the paper creates a new understanding for the operationalization of the Futures Map concept for practical use in organizations.

Theoretical background

The theoretical background of the research is based on a literature review regarding key futures research concepts and methods, namely alternative futures images and paths also widely known as scenarios, visions and visioning, and roadmaps and roadmapping. Next, the origins, developments, and typical approaches of each are presented to provide an overview of the richness and depth of the theoretical and methodological backgrounds related to the development of the Futures Map Framework. In addition, the nature, capabilities, advantages, and disadvantages of roadmaps, scenarios, and visions are described and compared to convey their differences and motivate their integration.

Alternative futures images and paths and scenario planning

The literature surrounding alternative futures images and paths, typically referred to as scenarios, is not only vast, but the terminology is broad and a wide variety of techniques and methodologies have been developed over the 50 years that scenarios have been employed (see, for example, [17, 39, 40]). In the literature, terms such as thinking, analysis, planning, forecasting and learning are frequently linked with the concept 'scenario' [17] and across different fields and practices the term has multiple meanings and serves different purposes [41]. According to Bradfield et al. [17], almost all areas regarding scenarios are lacking consensus as, based on the literature, there are many dissimilar and sometimes conflicting definitions, principles, features, and methodological notions regarding the subject. More recently Spaniol and Rowland [24] have even argued that the lack of consensus regarding "the application of theory to support scenario methodology" is probably one of the rare issues about which the scholars in the field agree. Indeed,"few techniques in futures studies have given rise to so much confusion as scenarios" [42], but at the same time, scenarios are the most commonly used method in futures studies and one of the most widespread of foresight methods [41]. It has even been said, that "scenario development is the heart of futures studies" [43]. Nevertheless, this popularity has raised questions and issues regarding what constitutes scenario development and how scenarios are developed [43].

Defining scenarios

The concept of scenarios dates to the earliest recordings of human history as future has always interested people and scenarios have been used as an instrument to explore the future of society and institutions through utopias and dystopias, according to Bradfield et al. [17]. In the dictionary, there are multiple definitions for the word 'scenario' and its origins are in theatre and narrative arts [44]. According to Coates [45], the closest definition relating to what futurists do, is "an imagined sequence of events, esp. any of several detailed plans of possibilities.". Herman Kahn, who is widely recognized as a foundational figure of futures studies and scenario planning, defines a scenario as "a set of hypothetical events set in the future constructed to clarify a possible chain of causal events as well as their decision points" [39]. More generally, a "scenario is a story with plausible cause and effect links that connects a future condition with the present, while illustrating key decisions, events, and consequences throughout the narrative." [46].

The origins of the definitions are examples from the different fields in which scenarios have been used.

According to Coates [45], using scenarios in government, business and other organizations can be broadly divided into two categories: 1) scenarios portray a future state or a condition where the organization is situated to get its users to create and refine feasible options, plans and alternative actions addressing the scenario's implications, and 2) scenarios portray a future state in which a specific policy has been established to explore the implications of a specific option or a combination of options. Pierre Wack, once the head of scenario planning at Royal Dutch Shell, which is considered one of the most well-known examples of a company utilizing scenarios successfully, states that the aim of scenario planning is "to rediscover the original entrepreneurial power of foresight in contexts of change, complexity, and uncertainty" [47].

Different scenario typologies have been presented. While there is a lack of consensus regarding these typologies [16], "several typologies reflect the view that futures studies explore possible, probable and/or preferable futures" [16] as these three categories represent different approaches for thinking about the future. Accordingly, for example, Börjeson et al. [16] recognize 1) predictive scenarios considering what will happen in the form of forecasts or what-if scenarios, 2) explorative scenarios considering what can happen in the form of external or strategic scenarios and 3) normative scenarios considering how to reach a specific target in the form of preserving or transforming scenarios.

Approaches to scenario planning

As scenario planning has evolved, divergent and modified ways of performing it, and three schools of thought with distinctive development characteristics have emerged [17, 39]. The Intuitive Logics school, based on the definition and process methods used at Royal Dutch Shell, have been regarded as the gold standard of corporate scenario development, while different variations of the Shell approach to scenarios have been developed with a varying number of steps [17, 48]. The Probabilistic Modified Trends school, based on the work of Gordon, Helmer, and others at RAND, focuses on Trend-Impact Analysis and Cross-Impact Analysis [17]. The La Prospective school, based on the works of Gaston Berger and Michel Godet, has developed into a "largely mathematical and computer-based probabilistic approach to scenario development" and a blend of methodologies from the Intuitive Logics and Probabilistic Modified Trends schools [17].

Generally, scenario planning models include a series of phases, stages, or steps in a linear or chronological process. Conversely, repeating phases and iteration are characteristics of recursive models. [49] While there are many different kinds of scenario planning methods, one of the most well-known is the 2× 2 matrix method or the Critical Uncertainties method developed by Peter Schwartz and Jay Ogilvy [50, 51]. Schwartz [51] describes eight steps for the scenario planning process:

1. Identifying the focal issue or decision
2. Identifying key factors in the local environment
3. Identifying driving forces in the macro environment
4. Ranking key factors and driving forces by impact and uncertainty
5. Selecting scenario logics
6. Fleshing out the scenarios
7. Identifying implications
8. Selecting leading indicators and signposts

Since Schartz and Ogilvy, scholars and practitioners have developed many variations of the eight-step scenario planning process [50]. In a sense, the significance of the 2× 2 matrix method is evident in Chermack's [50] classification of scenario building approaches: 1) methods that do not rely on the 2× 2 matrix method or advocate for stepped structures of any kind (for example, the Oxford scenario planning approach [52], the Scenario-based planning [53]), 2) methods relying on the 2× 2 matrix method or some of its variations (for example, the 2× 2 matrix method [51], the 18-step method [54]), and 3) methods that are challenging to categorize and describe and represent a comparatively unique and targeted approach (for example, Four Futures [55]).

Roadmaps and roadmapping

During recent years, the use of roadmapping has developed popularity in foresight exercises [30]. However, confusion had been created by the numerous applications of roadmaps, especially in relation to the purpose and outcomes amongst the other tools and techniques for managing technology [22]. A contributing factor to this issue is that the term roadmapping or technology roadmapping is used by different people to mean differed ideas [19] and there is a lack of a common definition [21]. It has been argued that defining roadmapping has become challenging, since the term has indeed become popular, and any prospective document is called a roadmap [22].

Defining roadmaps

The roots of roadmapping are in the technology roadmapping of the North American automotive industry. Technology corporations Corning and Motorola were the first to successfully implement the practice. The latter used roadmapping during the late 1970 s to enable the alignment of technology and product development effectively as roadmaps integrating technology push with market pull. [56, 57] For the advancement of roadmapping, the development of an industry-level semiconductor

roadmap in the United States is considered a significant milestone since it was developed through the collaboration of competitive companies initially at the national level and then internationally ensuring the sector benefitted through common standards and infrastructure while securing public funding and support [56, 58]. Since then, roadmapping has been used at company, sector, and national levels [21, 59] and it has become a common technique for developing long-term planning strategies enabling overtime the alignment of market, product and technology [60]. For example, Phaal [61] identified over 2000 public domain roadmaps available on the Internet ranging from, e.g., policy, energy, defense, construction, life sciences and transport.

Indeed, roadmaps can be applied to many purposes from long range and strategic planning, program, product and process planning, and capability and knowledge asset planning [59]. There are numerous types of roadmaps, for example, science and research roadmaps, industry and cross-industry roadmaps, strategy roadmaps, technology roadmaps, market roadmaps, product roadmaps, product-technology roadmaps, enterprise roadmaps, project portfolio roadmaps, and project or issue roadmaps [30, 58, 61]. For example, technology roadmaps provide multidimensional views of an organization with the purpose of identifying investment opportunities before making decisions. [60] However, nodes and links, which are the key elements of roadmaps, are always included. When creating a roadmap, it is necessary to determine the nodes and their properties, the connections between the nodes, and the attributes of the connections. By using these key elements, roadmaps can take different formats depending on the needs of the roadmapping activity, the planned use of the outputs, and the selected tools. [30] As result, roadmaps have taken many formats including single or multiple layers with bars, tables, graphs, and various textual and visual representations [59].

From an alternate point of view, the term "road map" may be seen as "a layout of ways or routes that exist or might exist" [60] thus helping travelers to plan a trip and reach a specific destination. This analogy characterizes roadmapping as a method of providing a graphical representation of current and future technologies, products and markets, and their developmental path, aiding leaders in planning and aligning development strategies with business goals. [60]

Approaches to roadmapping

Roadmapping, referring to the process, can be performed with diverse goals and purposes in mind, whereas roadmaps, the process outputs, may refer to various aspects of a planning problem [22]. It has been argued that, as with many planning activities, the process is more valuable than the output since it promotes active communication and the formation of consensus amongst the participants [30, 59]. When roadmapping is an ongoing iterative process such as strategic roadmapping [62], rather than a one-time project, the benefits mentioned can manifest continuously.

The method of technology roadmapping supports the structuring of the planning process, visualizing the gaps in strategic planning, and aligning the future objectives and the current actions of an organization [60]. For Phaal et al. [59] roadmapping is an effective technique to provide support when managing technology and planning for investigating and explicating the interactions between organizational goals, technological resources, and changes in the environment. For Garcia and Bray [19] it is a mean of creating, organizing, and conveying information concerning key requirements and the performance criteria that should be met for the objectives to be considered achieved within an established timeframe. By design, technology roadmapping assists in creating consensus regarding specific needs and the technologies needed to address them. It enables experts to forecast developments of technology in directed areas and provides a structured approach to support the planning and coordination of technology initiatives within a single organization or across an industry. [19]

Various roadmapping models have been developed to support the usage of the different roadmap formats. However, following an accurate roadmapping process and format is thought to be considerably less important than understanding the actual needs and analyzing alternative technologies [19], however, many approaches exist. Garcia and Bray [19] provide a roadmapping approach formalizing the process to improve accessibility and overall utilization, consisting of three phases each with specific activities and goals. Phaal et al. [63] describe "a fast-start technology roadmapping approach" based on a set of workshops focused on market, product and technology issues to provide a way to understand the architecture of roadmaps and to initiate the roadmapping process quickly. Ahlqvist et al. [62] provide a three-stage model for developing assessed representations of organizational visions and the strategies for their realization through an iterative process called strategic roadmapping.

According to Phaal et al. [59], the generic three-level form by the European Industrial Research Management Association is the most common. It is a time-based chart consisting of several layers with both business-related and technological views [59]. The same kinds of elements are present in the multi-layered roadmap framework by

Phaal and Muller, which "can be considered as a dynamic business or systems framework, with the architecture of the roadmap providing a coherent and holistic structure (a common language) within which the development and evolution of the business or system and its components can be explored, mapped and communicated" [63].

Visions and visioning

As the future is not predetermined or predictable and future outcomes may be influenced by choices [1], it is reasonable to state that visions and visioning have a specific significance in the field of futures studies. Indeed, visioning is considered foundational and unique in futures studies [14], while no other field or discipline considers it as a typical or "otherwise taken-for-granted method" [15]. Nonetheless, the concept of 'vision' has many meanings, frequently ranging from an image of the future to a specific desirable futures image, even used interchangeably [20, 64]. Similarly, there seems to be a lack of a comprehensive theoretical understanding of visioning, and many alternative ways exist to conduct the process [20]. In addition, although many other approaches in futures studies are considered to open the future, visioning is thought to close the future [20]; visions and visioning ought to be developed further.

Defining visions

According to the Oxford English Dictionary [65], the term vision has a considerable number of meanings. It can be the act of seeing physically or with the mind's-eye, an object of sight, a person, or a scene of atypical beauty [65]. It is also, the "action or fact of seeing or contemplating something not actually present to the eye; mystical or supernatural insight or foresight", and "the ability to conceive what might be attempted or achieved" [65]. While at the same time, vision is a "thing actually seen", it is a highly imaginative, distinct and vivid type of a mental construct [65].

In futures studies, vision is closely related to images of the future. Although Fred Polak, whose work was foundational and who popularized the concept, focused on images of the future with more positive qualities [66]. Images of the future can nowadays be considered an umbrella term describing an unlimited amount of possible images of the future, of which some are probable, some plausible, some projected, some preposterous, and some also preferable [1, 5]. While an image of the future can be described as an "expectation about the state of things to come at some future time" [67], visions represent a specific subset of preferable, desirable or ideal images of the future [68] portraying the expectations of individuals or groups on influencing the future [20]. Based on context, there are also more specific descriptions of what visions are, e.g., a "statement of intentions that defines a destination or future state of affairs" [69], "a self-fulfilling prophecy" [70], "a preview of the annual report" set in the future [71], "an empowered success story of the company's future" [72], "expression of the organization's and stakeholders' values organized around a mission or purpose"[73], and "statement or image of the future we are committed to creating" [70].

In addition to the broad variety of definitions, visions are used in diverse contexts for various purposes [74]. For example, Van der Helm [20] categorized visions into seven distinct types based on their area of application or association with a specific approach: religious, humanistic, political, business or organizational, community, and personal visions. While each type includes differentiating characteristics, they are all future-oriented, depict an idealized future, and strive to align actions towards the desired direction [20, 74]. Thus, visions are always normative, subjective, and oriented towards both the future and action.

Interestingly, there is a difference in how the field of futures studies and the field of strategic management approach the definition of a vision. While in futures studies more often vision is depicted as an idealized, desirable image of the future, the management literature has for decades employed a more broadened view to include, for example, organizational philosophies, principles, values, purposes, and missions (see, for example, [75, 76]). This study approaches vision as such – a broader managerial concept with various characteristics, forms, functionings, and qualities in addition to the preferred image of the future an individual or a group is subscribed to creating.

Approaches to visioning

Visioning is defined as the process of developing a vision [68, 70, 73]. There are many ways to approach the process and "[d]ifferent approaches make sense based on the particular context"[73]. Frequently visioning is not conducted in isolation, but as a part of a foresight process which typically includes the development of scenarios [74]. In addition, roadmaps typically include and communicate a vision [30]. Thus, visioning, scenarios, and roadmaps have close connections in practice.

In general, visioning should be participatory and employ creativity and visualization [77]. Imagination, intuition, ideals, and iteration are essential [68]. A key consideration being, who should be involved in the process [78]. A key difference in approaches is if the vision is created before or after the other steps of the foresight process. When the other steps of the foresight process, such as environmental and horizon scanning, are conducted first, visioning can be more rooted in reality [73]. When a vision is created first, it is produced from a clean

slate and the result – at least an initial idea of the desired direction – can be used to direct the subsequent steps [73, 79]. The importance of openness cannot be understated. As Stewart [80] points, "What is can be a great barrier to what could be. Those who want to move forward through bold and effective change, should begin at the end – with where they want to be.". Both orders are valid, but it is important to consider potential dependencies between the methods and techniques used in order to achieve a sequence that can produce expected results within the process boundaries [77].

Visions are represented in many forms. Often a vision is crystallized into a vision statement, but the whole of a vision is much more [73]. A vision should be expressed and communicated in ways that allow the relevant actors to experience it and thus have an effect. In addition to vision statements, visions can be presented as desirable future states [77] with models such as ETPS [81] (or STEEP, PESTE, and other variations), the ethnographic futures framework Verge [82], or the Seven foundations of worldbuilding [83]. In addition, visions can be presented with metaphors, stories, images, videos, tables, timelines, and maps [20, 64, 77]. While the forms are plentiful, it is important to remember that "[v]isions and visions statements may be more important for what they do than what they say – it is the commitment to them and their effective implementation that makes the difference." [70]. As Ziegler [84] notes, "the future is not the domain of knowledge but of action".

Towards integration

There are different ways to classify and categorize methods used in futures research and foresight (see, for example, [15, 85]). According to Popper [27] foresight methods can be described by their nature and capabilities.

First, methods can be classified into three categories based on their nature: qualitative, quantitative, or semi-quantitative. Qualitative methods convey meanings related to events and perceptions grounded on subjectivity or creativity, whereas quantitative methods usually focus on measuring variables and utilising statistical analyses to either collect or produce data. Semi-quantitative methods translate subjective views, rational judgments, and expert assessments to measurable terms using mathematical principles. [27]

Second, capabilities refer to the abilities of methods "to gather or process information based on evidence, expertise, interaction or creativity" [27]. *Creativity* refers to the combination of original and imaginative thinking, which depends on the resourcefulness of skilled individuals or creative group effort. The skills and knowledge of individuals regarding a specific subject matter or domain is referred to as *expertise*. *Interaction* recognizes that expertise benefits from exposure to collaboration and critical thinking with other experts and non-experts. In addition, it is important to try and explain a certain phenomenon with supporting documentation and analysis as presented by *evidence*. That being said, the attributes are not exclusive or restrictive, but each activity integrates the different attributes – some more, some less. [27]

The attributes are the key ingredients of the Foresight Diamond used to visually represent the different aspects of foresight methods [27]. According to the Foresight Diamond, roadmapping is an expertise-based methodology whereas scenarios are based on interaction, expertise and/or creativity corresponding to which scenario method is used [27]. Both scenario planning and technology roadmapping are seen as expert judgmental forecasting alongside surveys and Delphi [86]. However, roadmapping has been criticized for too little of a scope for creativity, communication, and collaboration, and for the difficulties of understanding the outputs, especially when they are riddled with technical terms [30].

Similarly, roadmapping is considered a qualitative method, whereas scenario methods vary on a scale from the semi-quantitative quantitative scenarios to the qualitative scenarios [27]. As the field of scenarios is vast, a great number of scenario planning methods have been developed. It has been stated that scenario building techniques have evolved from the more quantitative towards the more qualitative and process-oriented approaches [39]. Some of the techniques depend on qualitative approaches and inputs and some extensively use statistical and computational tools. According to Amer et al. [39] quantitative methods are generally regarded as appropriate for exercises with a narrow scope and a short time horizon and qualitative methods well-suited for activities with a broad scope and a long time horizon. With longer time horizons the utility of quantitative methods decreases gradually, while qualitative approaches become increasingly useful [87]. Nevertheless, integrating qualitative and quantitative approaches in scenario planning can produce both rich and sound scenarios, i.e., better results. Therefore, qualitative, and quantitative approaches should be seen as complementary [39, 87].

Often, technology roadmapping adopts a "straight-line projection or a single scenario", rendering it less suitable in front of volatile, systemic, and unanticipated changes [32], while scenarios "systematically explore, create, and test consistent alternative future environments that encompass the broadest set of future operating conditions that the user might plausibly face" [46]. Technology roadmapping can therefore be considered normative as

Table 1 Comparing the advantages and disadvantages of roadmaps, scenarios, and visions, adapted and elaborated from [30]

	Roadmaps	Scenarios	Visions
Advantages	- Seek consensus for plans and actions - Integrate future to the present - Inform short-, medium- and long-term decisions and actions - Consolidate rich information content to single visualization - Describe actions and paths for development - Describe continuity	- Normative, explorative, or predictive - Explore alternative futures, their causes, characteristics, and effects - Promote open and creative thinking - Advocate interaction and participation	- Normative - Orient on a desirable future - Seek consensus for a highly desirable future - Promote participatory and open dialogue, imagination, intuition, ideals, and iteration - Produce positive, motivating, and energizing information - Create commitment and shared direction - Promote innovation and problem-solving - Open for learning and developing
Disadvantages	- Normative - Narrow thinking if consensus is achieved too early (rigidity) - As the target of the plan, might fix resources on a target future that is not reasonable in a changed action environment - Imply linear thinking - Produce results that can be difficult to communicate to people not involved in their creation - Too vague for the coordinated action based on the roadmap	- May miss relevant paths for progress in reality - May miss convincing causality to the futures described - Produce rich information which can be hard to understand - Open for different interpretations	- Miss convincing causality and paths to the desirable future - Focus on long-term lacking connection to short- and medium-term decisions and actions - May be too blurry, abstract, or too disconnected from reality to be actionable - Frustrate without progress - Risk of futile use of resources - Open for different inter pretations

opposed to exploratory [30], whereas scenarios may be normative, explorative, or predictive [16].

Interestingly, the Foresight Diamond does not explicitly feature visioning, or it might be considered as part of other methodologies. However, one could argue that visioning involves evidence, expertise, and especially interaction and creativity. Typically, visioning is qualitative, but can include quantitative aspects, too. Although visioning can commence from both explorative and normative foresight, visions are inherently normative.

There is specific encouragement to merge components of scenario planning with those of roadmapping; the methods have found to be complementary, both have certain advantages, and the advantages of each work to counter the disadvantages related to the other, especially for strategy processes and policy and dynamic and volatile environments [21, 30, 32]. Table 1 presents a comparison of the advantages and disadvantages of roadmaps, scenarios, and visions to communicate their differences and motivate their integration. As Strauss and Radnor [32] indicate, "[s]cenario planning could increase the flexibility and vision of roadmapping, capture and convey the full context of decisions, and enable anticipation of a broader range of possible changes". Utilizing scenarios in the roadmapping process could resolve at least some of the criticism towards roadmapping as a foresight method. The inclusion of scenarios can provide the otherwise normative roadmapping with an explorative dimension: "The linearity and isolation of roadmaps are eliminated with the application of a creative, interactive and collaborative scenario planning process" [30]. In addition, while roadmaps can be hard to interpret if one is not an expert, scenarios assist in presenting the narratives of possible, plausible, and desirable futures in a more accessible way to a wider audience [30].

In the literature, the concepts of scenarios, roadmaps, and visions have overlapping interpretations that do not promote their synergistic use in the strategic planning of organizations. We consider that the Futures Map Framework, which we will introduce in the next section, is able to promote the synergistic use of these concepts in an actionable way for strategic planning if we define these key concepts in the following manner. *Scenarios* are differing chains of the states of futures connected by decisions, actions, events, and their consequences, creating coherent narratives for possible futures. *Visions* are meaningful portrayals of the nature and characteristics of preferable and desirable futures to which an individual or a group is subscribed, conveying deliberate and emergent intentions and expectations of the actors on influencing the future. *Roadmaps* are alternative paths between present and futures' states from which one is selected for

the planned and committed realization effort to move towards the vision.

Framework development

In this section, we introduce the Futures Map Framework (FMF) and how it integrates roadmap, scenario, and vision approaches to provide synergy with the use of three time horizons, two boundaries, six pragmatic quality criteria, and an integrative practice-oriented foresight approach.

Towards the Futures Map Framework

When developing theory and approaches for futures studies, it is beneficial to work with something already known as that can provide a rich starting point, such as an easily understandable analogy [37, 88]. The big picture of futures research can be described as the futures landscape, a concept used in futures studies and some other fields. Geels [89] employs landscape as a metaphor to depict the large-scale, macro-level aspects of sociotechnical change, the context within which actors interact, in the Multi-Level Perspective (MLP) framework. Inayatullah [90] describes the futures landscape as a visual method for mapping the future and understanding the situation of an organization on different levels: 1) a jungle signifying a state of survival, 2) a chess-set representing strategy, effectiveness and responsiveness, 3) mountain tops depicting alternative futures and the broader organizational context, and 4) a star symbolizing the vision of the future. Tibbs [91, 92] earlier presented a similar notion of viewing the future as a psychological landscape, where an individual or an organization – a strategic actor – looks into the future. This strategic landscape includes 1) Self portraying of the strategic identity of the strategic actor, 2) a Chessboard describing the strategic environment, 3) a Mountain representing the strategic objective, and 4) a Star depicting the organization's purpose [91, 92].

The futures landscape can also be regarded as a dynamic futures scenery identified by actors applying foresight and portraying it with a map, a Futures Map [36, 74]. Futures Maps share many similarities with maps representing physical scenery. For example, both are visual representations used to depict observations with a specified aim and scope not only in order to create the map itself, but for the utilization of the information provided in the map to support decision-making and action (similar to the call by Chermack [50] for better connecting scenarios to actions). Both require framing that guide what to include in what detail, and who should be involved in the making of the map and who should be able to use it. In both cases, the quality of the map should also be verified to assure what is placed on the map corresponds to what was observed and generally adhering to specified quality criteria. Both maps enable the ability to anticipate what might lie ahead and what should be considered in decision-making and in the implementation of decisions. For example, selecting the paths that seem most suitable considering the resources and capabilities available or obtainable to achieve specific destinations. Furthermore, both maps describe dynamic scenery that can be significantly different at different point of time and thus can be experienced and traversed differently. The possibility to infer future events depends crucially on the context in which one operates. Depending on the context, the environment presented by the map can be known or unknown, stable or unstable, or something in between – much like physical environments.

The Futures Maps differ from maps representing physical scenery in that Futures Maps portray the temporal proximity of events or actions instead of physical proximity of physical entities. In addition, when maps representing physical scenery utilize specifically defined patterns and symbols to represent physical reality, futures research or foresight processes utilize many of the main concepts of futures studies to form a "comprehensive description of the outcomes of a futures research process" [33], creating a Futures Map.

Key concepts and components of the Futures Map Framework

The Futures Map is a visual representation of the outcomes of foresight. It is constructed from all the futures states (images) assessed as relevant and the relationships (paths) between them and the current state. These outcomes are portrayed on two axes: Time (x) and Desirability (y). Thus, assessments of time frames, desirability, and possibilities are also inherently included in Futures Maps. [33, 34] The FMF could also include a third dimension, Similarity (z), which could further indicate the differences between futures states and paths that would otherwise share similar desirability at some points in time.

The Futures Map, like the Futures Cone, provides views to future possibilities (see, for example, [5]). However, while the Futures Cone can depict many types of alternative futures independent of actors, the Futures Map includes subjectivity and dependency inherently to the actors. Consequently, this makes a Futures Map particularly suitable for visioning, visionary leadership and strategic management. While the concepts mission, values and purpose, which are tightly connected with the concept of vision in management (see, for example, [76]), are not explicit in the visual representation of the Futures Map Framework, they affect the assessments included in the foresight activities used to construct Futures Maps. Based on the earlier works by Kuusi, Cuhls, and

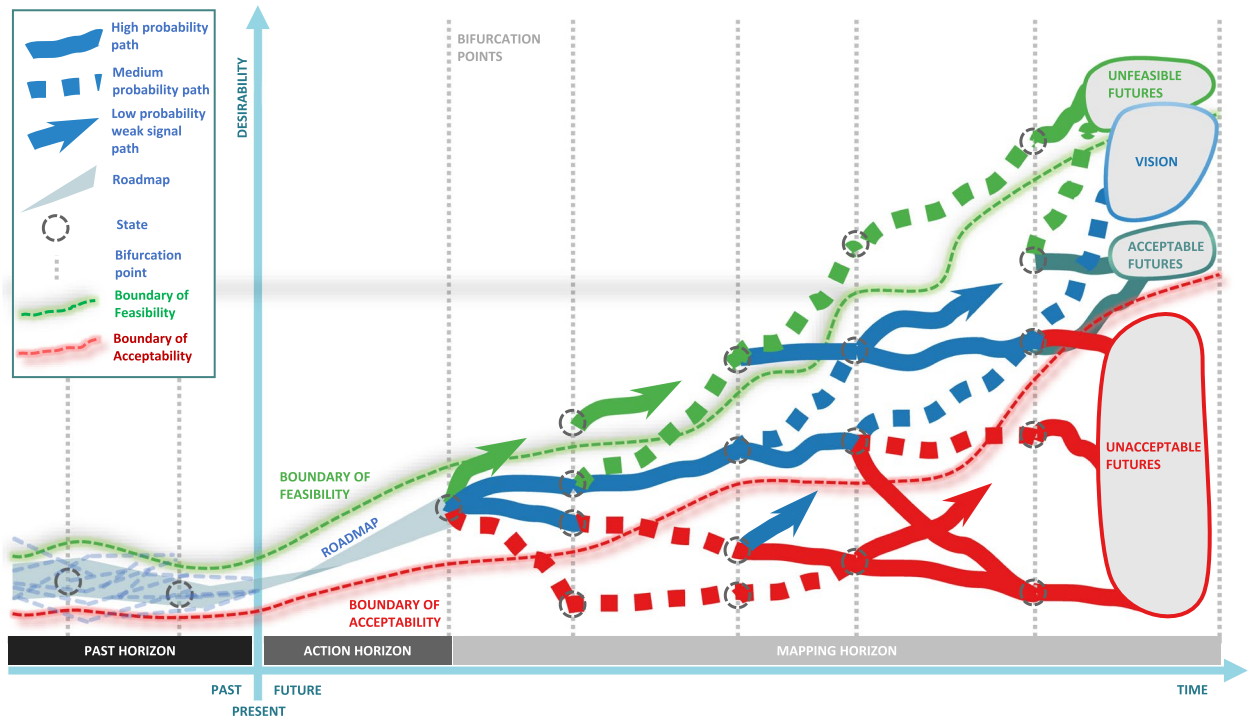

Fig. 1 Baseline Futures Map Framework, adapted and elaborated from [33, 36, 74]

Steinmüller [33, 34], Villman [74], and Kuusi and Villman [36], the developed Futures Map Framework is portrayed in Fig. 1. In the following, we will discuss the main concepts – time horizons and boundaries – and the related components.

Time horizons

Horizons have been used as a key component in futures or foresight frameworks. For example, the Three Horizons Framework [93, 94] portrays patterns of change over time: currently dominant, but over time failing patterns (Horizon 1), an envisioned desirable future through emerging patterns (Horizon 3), and the transitional patterns of innovation in between (Horizon 2). Furthermore, different timeframes such as short, medium, and long term have also been used as horizons.

In the Futures Map Framework, the three time horizons related to decision making are the key methodological choice: the Past Horizon, the shorter-term Action Horizon,[1] and the longer-term Mapping Horizon. The Past Horizon provides evidence for the other two horizons. Referring to the Table 1, we make an interpretation that seems to clarify the unclear relationship between the concepts of roadmaps and scenarios in futures research. The FMF suggests different roles for roadmaps and scenarios related to the Action Horizon and the Mapping Horizon. During the Action Horizon, the organization is committed to realizing the selected roadmap towards the vision. On the one hand, the Mapping Horizon scenarios open uncertainty with all its opportunities and risks for decision makers when they select the roadmap of the Action Horizon. On the other hand, the Mapping Horizon scenarios with new scenarios based on realized development are the frame for the construction of a new future roadmap that will follow and replace the roadmap of the earlier Action Horizon. Next, we describe the horizons in more detail.

The Past Horizon The Past Horizon describes the current state of the system in question, and both how and why the current state is as it is: what are the paths (dotted lines) that have led to the current state, why these paths, and how they came to fruition. These descriptions help to provide an understanding of the system in which the actors operate and how the past may influence the future. Path-dependencies influence the opportunity space especially in the shorter term, the Action Horizon, while

[1] The Action Horizon has been previously referred to as the Planning Horizon [34, 60, 79]. The name change is seen to reflect the focus of the horizon, which is to plan, commit to, and implement actions, more specifically than Planning. In addition, the change opens new avenues to alternative approaches that are not planning but action focused and more necessary in complex systems.

learning influences the longer term, the Mapping Horizon. The approaches utilized include, e.g., environmental and horizon scanning.

The Mapping Horizon The Mapping Horizon reflects the organization's vision, and the foreseeable events, futures states, and paths. Different approaches to scenario planning and richness of thinking about alternative futures images and paths form the methodological base [36]. Vision describes the shared dream future state and scenarios the identified pathways and images of the future as futures' states on the Mapping Horizon. Furthermore, bifurcation points describe decisions or events affecting the pathways and futures states on the Mapping Horizon. Attractors impact decision-making by influencing the 'attractiveness' of different options, while impacts present various alternative results after a bifurcation point. It is crucial to identify both leverage and tipping points to anticipate what kinds of consequences different decisions and events may have.

Depending on the organization's strategic approach, the Mapping Horizon can be viewed with at least the planning and visionary approaches, but perhaps also with the adaptive and transformative approaches [95]. In addition to having different desirabilities, futures states and paths have different probabilities of occurrence (from the continuous trajectories of the high probability paths to the highly contingent low probability weak signal paths), expected benefits, and required efforts and resources. Together these can communicate the expected value of each path as evaluated by the relevant stakeholders of the Futures Map.

The Action Horizon The Action Horizon reflects the organization's approach to prediction and control: what are the foreseeable events from the perspective of the organization and the decisions the organization can commit to [95]. Method-wise the Action Horizon tends towards roadmaps, but the roadmap is interpreted as a cone within which the users of the Futures Map aim to operate in [36]. The roadmap represents the 'path' the actors are committed to on the Action Horizon at the end of which there is a checkpoint. The path on which the action is focused is selected from the alternative roads of the roadmap and its final point is at the end of the Action Horizon. It is important to note that the Action Horizon may be affected by path-dependencies from the Past Horizon as indicated at the beginning of the Action Horizon in Fig. 1.

Depending on the context, for example, the pace of an industry or the organizational management system may affect the length of the Action Horizon and the requirements for adaptability, structures, and operating models. Thus, the Action Horizon can make use of more specific frameworks that align with the organization and its context to guide actions and learning. For example, the following can be used: innovation portfolios, simultaneous experimentation, sequential, cyclical, or iterative models, or specific agile methodologies.

Boundaries

Similar to what Börjeson et al. [16] call "boundary conditions" influencing the development of a system, the Futures Map Framework makes use of two boundaries: the Boundary of Feasibility (BoF) and the Boundary of Acceptability (BoA). The pathways between the boundaries are considered viable futures for the users of the Futures Map.

The Boundary of Feasibility acknowledges the internal ambitions, resources, capabilities, available external opportunity creators such as funding and innovations, and the related risks. In the Futures Map, feasibility relates to the realistic and perceivable maximum desirability level at a certain point in time due to, e.g., internal efforts and investments needed to achieve it or due to external limitations. The risk of investments that promote developments beyond the Boundary of Feasibility include lost resources especially if the expectations regarding the investments are not met. In contrast, future states previously considered unfeasible can become feasible through, for example, new technological innovations or regulatory changes.

The Boundary of Acceptability recognizes the internal expectations and external requirements on specified timeframes, i.e., what can be endured and sustained. In the Futures Map, acceptability separates the otherwise Acceptable futures states from the Unacceptable futures states that should be proactively avoided. If a future development path leads beyond the Boundary of Acceptability, drastic changes might be needed, including revision or even a change of vision, in order to enable continuity.

Six pragmatic quality criteria of the Futures Map Framework

In addition to the visual nature, the Futures Map Framework aims to provide an approach to assess the quality of the Futures Map as a whole – the creation, invention, examination, evaluation, and proposition of possible, probable, and preferable futures utilizing six pragmatic validity criteria. The quality criteria presented in Table 2 are adapted and elaborated from Kuusi, Cuhls, and Steinmüller [34] to improve their approachability.

Table 2 Six pragmatic validity criteria of the Futures Map Framework, adapted and elaborated from [34]

Cluster	Criterion	Name	Description
Anticipated developments	1	Richness	The number or the scope of possible futures that might be relevant from the point of view of the vision or acceptable futures based on available data (external input)
	2	Effectiveness	The most relevant or important possible futures are identified based on available data (external input)
Evidence of developments	3	Rich data	All kinds of causally relevant facts including weak signals are covered by the identified futures
	4	Effective data	Causally most relevant or influential facts are effectively interpreted for few scenarios or trends
Relevancy of anticipated developments	5	General utility	Many kinds of users of the Futures Map can understand and use it
	6	Focused utility	Key customers of the Futures Map can understand and benefit from the Map

The intent for the criteria is to guide a foresight process by, first, helping to clarify the objectives at the beginning of the process, and then, assessing how the criteria was later met. The futures researchers or foresight practitioners must choose which of the criteria are most relevant for the case and context and understand the implications for the foresight process and the Futures Map. For example, criteria two, four, and six can be considered most relevant for a selective foresight process like visioning, and explorative studies directed on the long-term may associate with criteria one, three and four. [33]

Baseline foresight process for the Futures Map Framework

Futures research and foresight processes are implemented in many ways. When there is a clear objective for the work, it is possible to prepare and design a fit-for-purpose process to achieve the defined objectives. However, it is possible to state, that futures research and foresight processes typically include the ensuing activities: defining the objectives and scope of the work, studying the current state of the subject in question, scanning potential changes in the subject's operational environment, identifying alternative futures images and related paths, and assessing impacts and options. Depending on the objective, the activities may also include the formation of a vision, and the creation of strategies and action plans to pursue the vision. [74] Furthermore, to lay the foundation for continuity, the overall activities related to the foresight work can include monitoring the actions and changes in the operational environment, communicating results, and institutionalizating foresight in the organization in question (see, for example, [55, 73, 74]).

All these activities are also seen as important for Futures Maps, and thus they are included in the baseline foresight process for the development and application of Futures Maps. Kuusi, Cuhls, and Steinmüller [34] used the concept "internal validity of the Futures Map" to describe how these general aspects of foresight processes are taken into account in the futures mapping process. What is different from fit-for-purpose process models, is that the baseline foresight process for Futures Maps is adaptable to various requirements. The baseline process can be viewed as a simple puzzle, which includes pieces that connect with other pieces. Instead of connecting with just one specific piece, some of the pieces can change places, but they need to remain in the same layer. The proposed baseline foresight process for the Futures Map Framework is presented in Fig. 2 as a three-layer model proceeding from the outer layer towards the center.

The baseline foresight process for Futures Maps always starts with Scoping, from the outer circle. The purpose of Scoping is to define what the aim of the activities is, what it is not, why the aims are important, how they will be approached, and with what resources, so that the work has a clearly stated frame. This includes scoping the process as a whole, defining the focal issue, identifying common and different features with earlier processes of a similar scope which concern relevant variables, assumptions and anticipated lines of development (compare to [96]). It also consists of defining the most relevant quality criteria and their implications for the process, identifying and analysing the stakeholders and their interests, and designing and structuring the process. It seems that is not typical nor at least explicit, to create an understanding of the nature of the context to plan and design the foresight process with the context and its characteristics and requirements in mind. However, these are the activities that should take place at the beginning of the Futures Map process, and possibly even at the beginning of all foresight processes. Moreover, Scoping functions as a means of setting the expectations regarding the activities from the offset and managing them through the whole process as expectations should be kept clearly in sight but also revisited during the process.

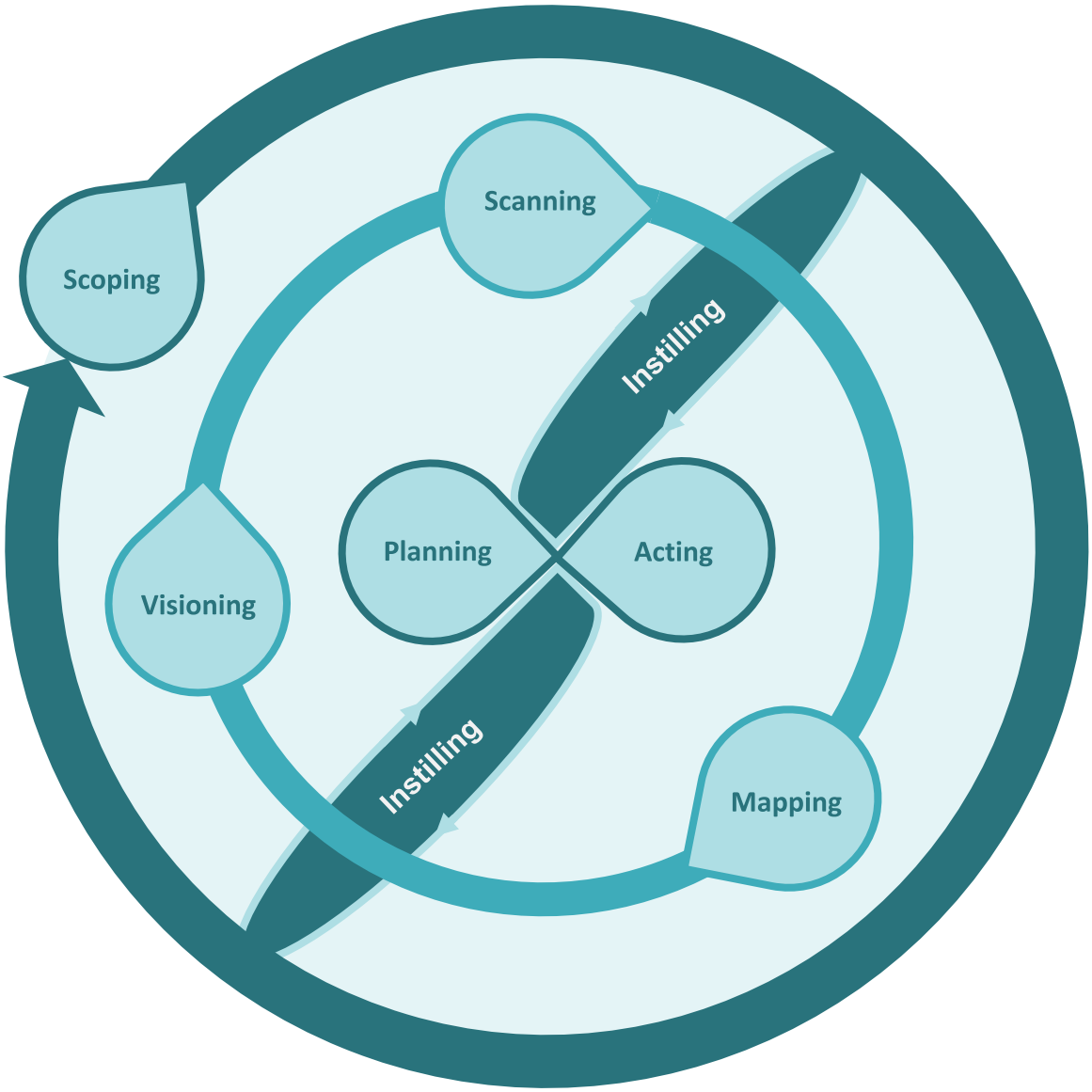

Fig. 2 Baseline foresight process for the Futures Map Framework

The next following steps are Scanning, Mapping and Visioning, which together form the Mapping Horizon – the second circle – but the order of the steps is dependent on the defined aims and the designed approach. The aim of Scanning is to, first, identify the current state, the conditions of the subject in question, what developments have led to it, and what developments are ongoing (path-dependencies). Then signals of change are explored in order to identify opportunities and threats, and in general, making sense of the observations. In Mapping the aim is to construct alternative scenarios including futures images and paths and assess and define the Boundary of Acceptability through desirability analysis. Especially in situations or environments with high uncertainty and complexity, the created scenarios can also be so-called mini-scenarios presenting even shorter timeframes than the whole Mapping Horizon and discontinuities within the FMF. With Visioning, the aim is to evaluate and revise the current vision (revision) or envision and construct a new shared vision which the actors can commit to.

After the vision and scenarios have been constructed, Planning follows. By first defining the Boundary of Feasibility, it is possible to develop strategies and options to proceed towards the vision. These strategies and options consider the realities and constraints of the context and thus enable the planning of more realistic actions to

which is it easier to commit to. In addition, it is important to define indicators that help identify if the impact of the actions taken lead to the results that were aimed for. After the plans have been established, Acting on the committed decisions and actions should follow. In addition to the actions, this includes the monitoring of set indicators, observation of both internal and external impacts, communication of the impacts, and learning from the actions and impacts. These actions form the base of the roadmap and the Action Horizon – the centre of the circle.

It is important to keep in mind that although a vision and a roadmap has been created, the future is not singular. In addition to the actions that need to be taken to advance towards the vision and observing what impacts are created, continuous foresight is needed to identify and interpret emerging changes in the operating environment, and to seize new opportunities and evade potential crises with the necessary course corrections. An essential question is, how to perceive, communicate, and maintain attention on the big picture, the present and changing environment, and the paths towards the preferred futures relative to the vision, past, current, and anticipated actions, and their potential impacts [74]. This is the aim of Instilling, which consists of formal approaches to designing and implementing the decisions and structures required to enable continuity for the foresight process. This can be done, for example, by creating organizational structures and practices to keep the process ongoing, agreeing the next time to perform the whole process, or agreeing on the conditions in which the process or parts of it need to be repeated (similar to [55]). In addition, Instilling includes the informal aspects of developing foresight capabilities and an anticipatory organizational culture by means of, for example, attention to and interactions regarding all-things-future, and the impacts these elements have on people individually and collectively. Thus, Instilling is visualized as an outside-in loop starting from Scoping and proceeding through the Mapping and Action Horizons before leading back to Scoping as an ongoing cycle.

Discussion

In this section, we discuss the application of the Futures Map Framework. In addition, we consider some widely employed theories and tools for which the FMF can provide foresight-enabling perspectives and thus open future research avenues.

On using the Futures Map Framework

We consider that Futures Maps can be useful and practical tools in futures studies and further support the linkage between futures and strategy. Similar to the use by Tibbs [91, 92] and Villman [74] of the metaphor of a journey, we view the utilization of Futures Maps as a journey which includes the following: continuous acts of developing an understanding of the evolving futures landscape, the actor's characteristics, the starting point, the past and current paths, and the preferred direction and destination; these are also integrated with committed actions and constant awareness, learning, and adaptation. It is a journey both of the inner self and the external world, that is, both of discovery and growth, and learning to navigate and engage in meaningful ways.

We consider that the key point of the Futures Map Framework is the synergy between a"perceived" or "evident" roadmap and a constructed scenario-based Futures Map. The FMF of an organization aims to combine the committed proceeding on the road that is selected from the "visible" roads of the roadmap on the Action Horizon and the long-term "poorly visible" possible developments of alternative scenarios on the Mapping Horizon. In other words, with these horizons, the Futures Map Framework is a tool to solve the controversy between effective but "possible futures blind" target-oriented action and a strategy that takes seriously into account those long-term future possibilities based just on recent weak signals. If an organization is in a situation with high uncertainties, its roadmap-based Action Horizon has to be short. It has to consider seriously various alternative scenarios of the Mapping Horizon and to be ready to change its "visible" roadmap-based action model. If the future is foreseeable, an organization can focus its activities on proceeding on the selected road and the means by which the members of the organization can achieve their committed targets.

A metaphor that illustrates the Futures Map is of a poor-quality terrain map, applied for the purpose of navigating to the top of a mountain nobody has ever reached before (the vision) in a largely unmapped area. At the beginning of the journey or during the travel but before the end of the Action Horizon there can be fewer surprises than later. Concerning the terrain of the Action Horizon, there is comparable trustful past evidence concerning what will likely be encountered. It might also be possible to observe what may lie ahead from the starting position or a current position. In addition, the relevant next steps might be revealed through experiments. Concerning what will be encountered after the Action Horizon, it is only possible to construct more or less trustful scenarios of the Mapping Horizon. However, when the end of the Action Horizon is reached, it is possible to make a new plan or to construct a new Action Horizon and evaluate the alternatives or scenario possibilities that will be met at the end of the new Action Horizon. Moreover, decisions and actions taken

up to this point during the endeavor will impact the real options that are possible later. Potential future paths are dependent, for example, on the level of preparedness, the capabilities, capacities, and skills acquired earlier, and the ability to learn and implement learnings. Some resources may have been acquired earlier, and some may be acquired during the journey. Past decisions and actions may have also created such momentum that a rapid change of direction might not be possible without exhaustive efforts and resources, or without a major external event or by applying force. It is important to notice that momentum can work for and against actors' actual interests. Finally, although, perhaps not reaching the top of the mountain or the stars, because it has been taken it into account in some of the scenarios, the visionary target can be replaced with another direction – 'mountain top' or North Star – that is acceptable or even more desirable from their current point of view.

Empirical use of the Futures Map Framework is required for further validation. For example, studies should be conducted in diverse contexts to learn more about the general applicability of the Futures Map Framework for different types of contexts. Contexts and contextuality present an interesting line of inquiry for future research.

In a number of foresight processes visioning takes place after the horizon scanning activities, that is, after gaining an understanding of the potential changes and materialization (see, for example, [73, 80]). On the other hand, it may be valuable to perform visioning first in order to understand the desired direction and to preliminarily guide the rest of the activities with improved aim and efficiency [79]. This is the case with the original process used to create a Futures Map as described by Kuusi and Kamppinen [79]. Nevertheless, the vision should act as a guide to direction, but not limit the opportunities for seizing future value that was not originally observed or had not yet emerged [7].

Similarly, the order between creating scenarios and visioning is dependent on the defined approach. If the purpose is to use scenarios to discover potential opportunities and then evaluate what opportunities seem most desirable, it is possible to create explorative scenarios with forecasting-based approaches and subsequently construct the vision. This can be called the explorative Futures Map approach. If the purpose is to use the vision as a reference point to the creation of scenarios, the vision must be formed first. Then, the scenarios – which in this case are normative – can be created from the vision towards the present with backcasting-based approaches. This can be called the normative Futures Map approach.

In addition, there are four further factors regarding the baseline foresight process. First, while the baseline foresight process for the Futures Map Framework may be linear to some degree, as at least initial conditions need to be met in each layer to continue to the next, but the layers and steps may also overlap and there can be loops both backward and forward. Second, the process is designed to be continuous or at least cyclical. Third, each step of the process can make use of methods and techniques perceived to fit the aim, purpose, resource availability, and context of use. This is similar to the Framework Foresight method [73, 97, 98], which outlines steps for foresight processes and a set of basic guidelines and tools for each step, but leaves the selection of most appropriate tools at the users' discretion. Lastly, it is advisable to maintain shared understanding of the situation at hand and, for example, discuss potential changes affecting the process while it is ongoing and anticipate potential needs for adaptation to manage expectations throughout.

Future research avenues

As potential research avenues, the Futures Map Framework could provide novel foresight-enabling perspectives to other theories and tools. A key challenge is to help organizations develop visionary leadership and form both efficient and sustainable practices. As Fidler [99] states, "[f]oresight is most effective in the context of rapid probable change but in the absence of corresponding experience.". This can present a challenge for futures thinking in general but also provides an essential motivator for anticipating alternatives to business-as-usual futures.

Sytnik and Proskuryakova [100] explored the expansion of foresight methodologies with theoretical approaches and methods from complex system studies to improve the discovery and processing of unknowns. Here an important question is, how could current management theories, practices, and tools be approached to consider the dynamic futures scenery constructed and explored with the Futures Map Framework. For practical applications, the Futures Map Framework could be reflected upon using, for example, the theory of paradox [101], the real options theory [102], the Doughnut economics framework [103], and the Cynefin framework [104–106]. In addition, new technologies can have major impacts to futures research and foresight processes.

First, the Futures Map embraces paradoxes: short-term and long-term benefits must be considered and purposeful planning and space for emergence must be created simultaneously. For example, while the Futures Map can simplistically represent progress in one path, it is also possible to branch out to multiple experimental directions simultaneously.

Second, real options can underlie organizational resilience as real options are used to enable greater flexibility which in turn creates greater resilience. Alternative futures require and create different real options. For example, a greater variety of real options enable better positioning for opportunistic behaviors. Visionary management is used to create strategic and operative real options. The Futures Map assists in the identification of the required real options for desirable future paths and supports decision-making and monitoring.

Third, the Futures Map may have two complementary aspects with the Doughnut economics framework. First, the boundaries of the Futures Map can be considered to be the hole in the middle of the doughnut which denotes a falling short and the outside as shooting over a goal. If the progress on the Futures Map is below the lower Boundary of Acceptability, the outcomes will be less than those expected or demanded. If the progress is shooting over the upper Boundary of Feasibility, the outcomes are more than what is realistic or even needed. In addition, the doughnut model could be used to describe any state on the Futures Map, which then could be used to estimate the desirability of that future state.

Fourth, as a sense-making framework designed to support decision-making, the aim of the Cynefin Framework is to be able to understand different contexts and act in contextually appropriate ways as opposed to, for example, acting based on personal characteristics or preferences [106]. Similarly, futures research is not a one-size-fits-all -type of activity, because context matters. Thus, a relevant question is, what are the limitations of the Futures Map Framework context-wise. We hypothesize that the FMF can be used in various contexts with different configurations, and this could further improve the real-world applicability of the framework.

Fifth, advancements in technologies are not only enabling new types of interactions between people in futures research processes but also creating new ways of creating and experiencing content, i.e., futures knowledge in this case. For example, generative artificial intelligence and extended reality technologies can provide novel opportunities for Futures Maps from their conception to how they are communicated, experienced, criticized, and revised.

Conclusions

In this paper, we have developed the Futures Map Framework (FMF), an integrative hybrid foresight approach, and outlined a baseline foresight process for its applications. The FMF is a versatile base for integrating alternative futures images and paths, roadmapping, and visioning with both managerial and entrepreneurial decision-making. The FMF helps to first identify and then act on actionable futures from the perspective of its intended actors.

The theoretical contribution of this paper is in the interpretation of visions, scenarios, and roadmaps in a synergistic manner, introducing the distinction between the Mapping Horizon and the Action Horizon, combining past, present, and future time horizons in the proposed Futures Map Framework. It also proposes a foresight approach for a practice-oriented integration of these horizons. The development from the conceptual level to the methodological level is important for the operationalization and maturation of the Futures Map and provides a contribution to the advancement of hybrid futures research methodologies. In addition, further research and development avenues for the Futures Map Framework are many from the perspective of the limitations of this study and the discussed theories and tools, but empirical research is especially needed to validate the usability of the Futures Map Framework through real-world use cases. Therefore, we welcome research evaluating and further elaborating the FMF, and the development of other integrative hybrid foresight approaches.

Acknowledgements
TV wishes to thank Jari Kaivo-oja, Liisa Haapanen, Mikkel Stein Knudsen, and Toni Ahlqvist for their valuable feedback on the earlier versions of this manuscript, and several company representatives who generously shared their insights during informal discussions, helping to refine the practical considerations of this work. The authors thank the anonymous reviewers for their constructive and insightful comments, which helped to refine and strengthen the final version of this article.

Authors' contributions
TV: conceptualization, methodology, writing – original draft, writing—review and editing, visualization, supervision, project administration. OK: conceptualization, writing – review and editing. All authors read and approved the final manuscript.

Funding
TV wants to acknowledge funding by Business Finland projects Sustainable Futures (178/31/2023) and LifeFactFuture (6819/31/2023).

Data availability
Not applicable.

Declarations

Ethics approval and consent to participate
Not applicable.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

Received: 30 January 2025 Accepted: 2 May 2025
Published online: 21 October 2025

References

1. Amara R (1981) The futures field: searching for definitions and boundaries. The Futurist 15:25–29
2. Bell W (2002) Advancing futures studies: a reply to Michael Marien. Futures 34:435–447. https://doi.org/10.1016/S0016-3287(01)00070-2
3. Minkkinen M (2020) A breathless race for breathing space : Critical-analytical futures studies and the contested co-evolution of privacy imaginaries and institutions
4. Voros J (2001) A Primer on Futures Studies, Foresight and the Use of Scenarios. Prospect: The Foresight Bulletin 6
5. Voros J (2017) Big History and Anticipation. In: Poli R (ed) Handbook of Anticipation: Theoretical and Applied Aspects of the Use of Future in Decision Making. Springer International Publishing, Cham, pp 1–40
6. Bell W (1997) Foundations of Futures Studies, Volume 1: Human Science for a New Era. Transaction Publishers, New Brunswick, NJ
7. Dator J (2019) What Futures Studies Is, and Is Not. In: Dator J (ed) Jim Dator: A Noticer in Time: Selected work, 1967–2018. Springer, Cham, pp 3–5
8. Minkkinen M, Auffermann B, Ahokas I (2019) Six foresight frames: Classifying policy foresight processes in foresight systems according to perceived unpredictability and pursued change. Technol Forecast Soc Chang 149:119753. https://doi.org/10.1016/j.techfore.2019.119753
9. Lum R (2002) When in doubt, vision your way out. Futures 34:471–477. https://doi.org/10.1016/S0016-3287(01)00074-X
10. van Knippenberg D, Stam D (2014) Visionary Leadership. In: Day DV (ed) The Oxford Handbook of Leadership and Organizations. Oxford University Press, pp 241–259
11. Kohles JC, Bligh MC, Carsten MK (2013) The vision integration process: Applying Rogers' diffusion of innovations theory to leader–follower communications. Leadership 9:466–485. https://doi.org/10.1177/1742715012459784
12. M. Taylor C, J. Cornelius C, Colvin K, (2014) Visionary leadership and its relationship to organizational effectiveness. Leadersh Org Dev J 35:566–583. https://doi.org/10.1108/LODJ-10-2012-0130
13. Westley F, Mintzberg H (1989) Visionary leadership and strategic management. Strateg Manag J 10:17–32. https://doi.org/10.1002/smj.4250100704
14. Inayatullah S (2013) Futures Studies: Theories and Methods. In: Gutierrez Junquera F (ed) There's a Future. Visions for a Better World. BBVA, Madrid, pp 36–66
15. Poli R (2018) A note on the classification of future-related methods. European Journal of Futures Research 6:15. https://doi.org/10.1186/s40309-018-0145-9
16. Börjeson L, Höjer M, Dreborg K-H, Ekvall T, Finnveden G (2006) Scenario types and techniques: Towards a user's guide. Futures 38:723–739. https://doi.org/10.1016/j.futures.2005.12.002
17. Bradfield R, Wright G, Burt G, Cairns G, Heijden K (2005) The origins and evolution of scenario techniques in long range business planning. Futures 37:795–812. https://doi.org/10.1016/j.futures.2005.01.003
18. Chermack T (2002) The mandate for theory in scenario planning. Futur Res Q 18:25–28
19. Garcia ML, Bray OH (1997) Fundamentals of technology roadmapping. Sandia National Lab. (SNL-NM), Albuquerque, NM
20. van der Helm R (2009) The vision phenomenon: Towards a theoretical underpinning of visions of the future and the process of envisioning. Futures 41:96–104. https://doi.org/10.1016/j.futures.2008.07.036
21. Hussain M, Tapinos E, Knight L (2017) Scenario-driven roadmapping for technology foresight. Technol Forecast Soc Chang 124:160–177. https://doi.org/10.1016/j.techfore.2017.05.005
22. Kappel TA (2001) Perspectives on roadmaps: how organizations talk about the future. J Prod Innov Manag 18:39–50. https://doi.org/10.1111/1540-5885.1810039
23. Martelli A (2001) Scenario building and scenario planning: State of the art and prospects of evolution. Futur Res Q 17:57–70
24. Spaniol MJ, Rowland NJ (2018) The scenario planning paradox. Futures 95:33–43. https://doi.org/10.1016/j.futures.2017.09.006
25. Courtney H, Kirkland J, Viguerie P (1997) Strategy under uncertainty. Harv Bus Rev 75:66–79
26. Courtney H (2003) Decision-driven scenarios for assessing four levels of uncertainty. Strategy & Leadership 31:14–22. https://doi.org/10.1108/10878570310455015
27. Popper R (2008) How are foresight methods selected? Foresight 10:62–89. https://doi.org/10.1108/14636680810918586
28. Tapio P, Rintamäki H, Rikkonen P, Ruotsalainen J (2017) Pump, boiler, cell or turbine? Six mixed scenarios of energy futures in farms. Futures 88:30–42. https://doi.org/10.1016/j.futures.2017.03.003
29. Myllylä Y, Kaivo-oja J (2024) A hybrid foresight study of the environmental reference laboratory system in Finland: a foresight study for the Government of Finland. European Journal of Futures Research 12:2. https://doi.org/10.1186/s40309-023-00223-z
30. Saritas O, Aylen J (2010) Using scenarios for roadmapping: The case of clean production. Technol Forecast Soc Chang 77:1061–1075. https://doi.org/10.1016/j.techfore.2010.03.003
31. Saritas O, Dranev Y, Chulok A (2017) A dynamic and adaptive scenario approach for formulating science & technology policy. Foresight 19:473–490. https://doi.org/10.1108/FS-11-2016-0054
32. Strauss JD, Radnor M (2004) Roadmapping for Dynamic and Uncertain Environments. Res Technol Manag 47:51–58. https://doi.org/10.1080/08956308.2004.11671620
33. Kuusi O, Cuhls K, Steinmüller K (2015) Quality criteria for scientific futures research. Futura 34:60–77
34. Kuusi O, Cuhls K, Steinmüller K (2015) The futures Map and its quality criteria. European Journal of Futures Research 3:1–14. https://doi.org/10.1007/s40309-015-0074-9
35. Kamppinen M, Kuusi O, Söderlund S (2002) Tulevaisuudentutkimus: perusteet ja sovelluksia. Suomalaisen Kirjallisuuden Seura, Helsinki
36. Kuusi O, Villman T (2022) Tulevaisuuskartta tulevaisuuksientutkimuksen kokoavana viitekehyksenä. In: Aalto H-K, Heikkilä K, Keski-Pukkila P, Mäki M, Pöllänen M (eds) Tulevaisuudentutkimus tutuksi – Perusteita ja menetelmiä. University of Turku, Turku School of Economics, pp 113–124
37. Malaska P, Virtanen I (2009) Theory of futuribles and historibles Futura 28:65–84
38. de Jouvenel B (1967) The Art of Conjecture. Basic Books, New York, NY
39. Amer M, Daim TU, Jetter A (2013) A review of scenario planning. Futures 46:23–40. https://doi.org/10.1016/j.futures.2012.10.003
40. Varum CA, Melo C (2010) Directions in scenario planning literature – A review of the past decades. Futures 42:355–369. https://doi.org/10.1016/j.futures.2009.11.021
41. Ramirez R, Mukherjee M, Vezzoli S, Kramer AM (2015) Scenarios as a scholarly methodology to produce "interesting research." Futures 71:70–87. https://doi.org/10.1016/j.futures.2015.06.006
42. Khakee A (1991) Scenario construction for urban planning. Omega 19:459–469. https://doi.org/10.1016/0305-0483(91)90062-X
43. Bishop P, Hines A, Collins T (2007) The current state of scenario development: an overview of techniques. Foresight 9:5–25. https://doi.org/10.1108/14636680710727516
44. scenario, n. meanings, etymology and more. In: Oxford English Dictionary. https://www.oed.com/dictionary/scenario_n?tab=meaning_and_use#24174427. Accessed 19 Feb 2024
45. Coates JF (2000) Scenario Planning. Technol Forecast Soc Chang 65:115–123. https://doi.org/10.1016/S0040-1625(99)00084-0
46. Glenn J (2009) Scenarios. In: Glenn J, Gordon T (eds) Futures Research Methodology, Version 3.0. The Millennium Project, Washington, DC
47. Wack P (1985) Scenarios: Shooting the Rapids. Harv Bus Rev 63:139–150
48. Millett S (2003) The future of scenarios: challenges and opportunities. Strategy & Leadership 31:16–24. https://doi.org/10.1108/10878570310698089
49. Rowland NJ, Spaniol MJ (2017) Social foundation of scenario planning. Technol Forecast Soc Chang 124:6–15. https://doi.org/10.1016/j.techfore.2017.02.013
50. Chermack TJ (2022) Using Scenarios: Scenario Planning for Improving Organizations. Berrett-Koehler Publishers, Oakland, CA
51. Schwartz P (1997) The Art of the Long View: Planning for the Future in an Uncertain World, Reprint edition. John Wiley & Sons, Ltd
52. Ramírez R, Wilkinson A (2016) Strategic Reframing: The Oxford Scenario Planning Approach. Oxford:Oxford University Press
53. Heijden K van der (2004) Scenarios: The Art of Strategic Conversation, 2nd Edition, 2nd edition. John Wiley & Sons, Ltd, West Sussex, England; Hoboken, N.J
54. Ralston B, Wilson I (2006) The Scenario-planning Handbook: A Practitioner's Guide to Developing and Using Scenarios to Direct Strategy in Today's Uncertain Times. Thomson South-Western, Mason, OH

55. Dator J (2009) Alternative futures at the Manoa School. J Futures Stud 14(2):1–18
56. Phaal R, Farrukh CJP, Probert DR (2005) Developing a technology roadmapping system. In: A Unifying Discipline for Melting the Boundaries Technology Management: pp 99–111
57. Probert D, Radnor M (2003) Technology roadmapping: Frontier experiences from industry-academia consortia. Research Technology Management 46:26–30
58. Kostoff RN, Schaller RR (2001) Science and technology roadmaps. IEEE Trans Eng Manage 48:132–143. https://doi.org/10.1109/17.922473
59. Phaal R, Farrukh CJP, Probert DR (2004) Technology roadmapping—A planning framework for evolution and revolution. Technol Forecast Soc Chang 71:5–26. https://doi.org/10.1016/S0040-1625(03)00072-6
60. Loureiro AMV, Borschiver S, de Coutinho PL, A, (2010) The Technology Roadmapping Method and Its Usage in Chemistry. J Technol Manag Innov 5:181–191. https://doi.org/10.4067/S0718-27242010000300013
61. Phaal R (2011) Public-Domain Roadmaps. University of Cambridge, Centre for Technology Management
62. Ahlqvist T, Dufva M, Kettle J, Vanderhoek N, Valovirta V, Loikkanen T, Roos G, Hytönen, Niemelä, Kivimaa A (2013) Strategic roadmapping, industry renewal, and cluster creation: the case Green Triangle. Melbourne, Australia
63. Phaal R, Muller G (2009) An architectural framework for roadmapping: Towards visual strategy. Technol Forecast Soc Chang 76:39–49. https://doi.org/10.1016/j.techfore.2008.03.018
64. Auvinen H, Tuominen A, Ahlqvist T (2012) Towards long-term foresight for transport: envisioning the Finnish transport system in 2100. Foresight 14:191–206. https://doi.org/10.1108/14636681211239746
65. vision, n. meanings, etymology and more. In: Oxford English Dictionary. https://www.oed.com/dictionary/vision_n. Accessed 30 Jan 2025
66. Polak F (1973) The Image of the Future. Elsevier Scientific Publishing Company, Amsterdam
67. Bell W, Mau JA (1971) The Sociology of the future; theory, cases, and annotated bibliography. Russell Sage Foundation, New York, NY
68. Schultz W (1995) Futures fluency : explorations in leadership, vision, and creativity. Thesis (Ph. D.), University of Hawaii at Manoa
69. Nanus B (1996) Leading the vision team. The Futurist 30:20
70. Bezold C, Peck J, Bettles C, Olson B (2009) Using Vision in Futures. In: Glenn J, Gordon T (eds) Futures Research Methodology, Version 3.0. The Millennium Project, Washington, D.C
71. Wilson I (1992) Realizing the power of strategic vision. Long Range Plan 25:18–28. https://doi.org/10.1016/0024-6301(92)90271-3
72. Holstius K, Malaska P (2004) Advanced strategic thinking: visionary management
73. Bishop PC, Hines A (2012) Teaching about the Future. Palgrave Macmillan UK, London
74. Villman T (2021) 'The preferred futures of a human-centric society : A case of developing a life-event-based visioning approach'. Master's thesis, Turku: Finland Futures Research Centre, Turku School of Economics, University of Turku. https://www.utupub.fi/handle/10024/151334
75. Bleicher K (1994) Integrative management in a time of transformation. Long Range Plan 27:136–144. https://doi.org/10.1016/0024-6301(94)90234-8
76. Collins JC, Porras JI (1991) Organizational Vision and Visionary Organizations. Calif Manage Rev 34:30–52. https://doi.org/10.2307/41166682
77. Wiek A, Iwaniec D (2014) Quality criteria for visions and visioning in sustainability science. Sustain Sci 9:497–512. https://doi.org/10.1007/s11625-013-0208-6
78. Stevenson T (2006) From vision into action. Futures 38:667–672. https://doi.org/10.1016/j.futures.2005.10.009
79. Kuusi O, Kamppinen M (2002) 'Tulevaisuuden tekeminen'. In: Tulevaisuudentutkimus: perusteet ja sovelluksia. Suomalaisen Kirjallisuuden Seura toimituksia 896. Helsinki: Suomalaisen Kirjallisuuden Seura
80. Stewart JM (1993) 'Future state visioning—A powerful leadership process'. Long Range Planning 26(6):89–98. https://doi.org/10.1016/0024-6301(93)90210-7
81. Aguilar FJ (1967) Scanning the Business Environment. Macmillan, New York, NY
82. Lum R (2014) Working with Verge. In: APF Compass Methods Anthology. Association of Professional Futurists
83. Zaidi L (2017) Building Brave New Worlds: Science Fiction and Transition Design
84. Ziegler W (1991) Envisioning the future. Futures 23:516–527. https://doi.org/10.1016/0016-3287(91)90099-N
85. Futures Research Methodology – Version 3.0 – The Millennium Project. https://www.millennium-project.org/publications-2/futures-research-methodology-version-3-0/. Accessed 5 Aug 2022
86. Cho Y, Yoon S-P, Kim K-S (2016) An industrial technology roadmap for supporting public R&D planning. Technol Forecast Soc Chang 107:1–12. https://doi.org/10.1016/j.techfore.2016.03.006
87. Pillkahn U (2008) Using Trends and Scenarios as Tools for Strategy Development: Shaping the Future of Your Enterprise, 1st edn. Publicis, Erlangen
88. Malaska P, Virtanen I (2017) Theory of Futuribles and Historibles. In: Kuusi O, Heinonen S, Salminen H (eds) How Do We Explore Our Futures? The Finnish Society for Futures Studies
89. Geels FW (2002) Technological transition as evolutionary reconfiguration processes: a multi-level perspective and a case-study. Research Policy 31:1257–1274. https://doi.org/10.1016/S0048-7333(02)00062-8
90. Inayatullah S (2008) Six pillars: futures thinking for transforming. Foresight 10:4–21. https://doi.org/10.1108/14636680810855991
91. Tibbs H (1999) Making the Future Visible: Psychology, Scenarios, and Strategy. Australian Public Service Futures Group, Canberra
92. Tibbs H (2021) Making the Future Visible: Psychology, Scenarios, and Strategy. World Futures Review 13:8–13. https://doi.org/10.1177/19467567211014557
93. Curry A, Hodgson A (2008) Seeing in Multiple Horizons: Connecting Futures to Strategy. Journal of Futures Studies 13:1–20
94. Sharpe B, Hodgson A, Leicester G, Lyon A, Fazey I (2016) Three horizons: a pathways practice for transformation. Ecology and Society 21. https://doi.org/10.5751/ES-08388-210247
95. Wiltbank R, Dew N, Read S, Sarasvathy SD (2006) What to do next? The case for non-predictive strategy. Strateg Manag J 27:981–998. https://doi.org/10.1002/smj.555
96. Cukier K, Mayer-Schönberger V, Véricourt F de (2021) Framers: Human Advantage in an Age of Technology and Turmoil. Dutton, New York, NY
97. Hines A (2020) Evolution of framework foresight. Foresight 22:643–651. https://doi.org/10.1108/FS-03-2020-0018
98. Hines A, Bishop PC (2013) Framework foresight: Exploring futures the Houston way. Futures 51:31–49. https://doi.org/10.1016/j.futures.2013.05.002
99. Fidler D (2011) Foresight defined as a component of Strategic Management. Futures 43:540–544. https://doi.org/10.1016/j.futures.2011.02.005
100. Sytnik VM, Proskuryakova LN (2024) Expanding foresight methodology to better understand the unknown future and identify hard-to-predict events. European Journal of Futures Research 12:21. https://doi.org/10.1186/s40309-024-00244-2
101. Smith W, Lewis M (2011) Toward A Theory of Paradox: A Dynamic Equilibrium Model of Organizing. The Academy of Management Review 36. https://doi.org/10.5465/AMR.2011.59330958
102. Myers SC (1977) Determinants of corporate borrowing. J Financ Econ 5:147–175
103. Raworth K (2012) A safe and just space for humanity: Can we live within the doughnut. Oxfam Discussion Paper. Oxfam International, Oxford
104. Kurtz CF, Snowden DJ (2003) The new dynamics of strategy: Sense-making in a complex and complicated world. IBM Syst J 42:462–483. https://doi.org/10.1147/sj.423.0462
105. Snowden D, Rancati A (2021) Managing complexity (and chaos) in times of crisis. A field guide for decision makers inspired by the Cynefin framework. In: JRC Publications Repository. https://publications.jrc.ec.europa.eu/repository/handle/JRC123629. Accessed 9 Sep 2022
106. Snowden DJ, Boone ME (2007) A Leader's Framework for Decision Making. Harv Bus Rev 85:68–76

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