Systemic Foresight Methodology

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Chapter 6
Systemic Foresight Methodology

Ozcan Saritas

6.1 Introduction

As an unavoidable human trait of thinking about the future, foresight has been practiced since the existence of the first human being on earth. The use of individual foresight in a collective and participative way, however, is a rather new phenomenon, which led to today's formal, institutionalized Foresight. More recently Foresight has been a widely acclaimed activity associated with policy making by government, industry and other organisations to shape the society's future. As the complexity of societies has increased, the scope of Foresight activities has widened to cover a wide variety of issues. This has been mainly due to the increasing importance of technological and organisational innovation; the development of service economies; and other developments such as rapid globalisation, and changing nature of demographical structures, cultural practices, environmental affairs and social services.

Foresight practice has evolved in time to address the expectations of various stakeholders and challenges of their times. For instance, the Foresight practice in the 50s and 60s was mainly characterised by the forecasting of the future technologies mainly for defence purposes as required by the conditions of the cold war in the post-WW2 period. The nature of the situations has changed in time and so as the Foresight practice. This paper mainly considers the complexities

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and uncertainties of the current world and discusses how Foresight practice can be more responsive to tackle with today's more 'systemic' situations involved in human and social systems, which are 'open' in nature and require more customised methodological approaches. This paper introduces the Systemic Foresight Methodology (SFM) as a way to cope with the complexities of the human and social systems and to develop a more tailored Foresight methodology with the integration of qualitative and quantitative Foresight tools in line the nature of situations. The need for systems thinking and adapting Foresight into its context have been highlighted (see Aaltonen and Sanders 2006; Salo et al. 2004; Forlearn[1]). Besides acknowledging these necessities with systems theory and practical evidence, the SFM sets out to create systemic concepts and methodological frameworks that are useable for future-oriented idea creation in complex human and social systems. It considers the Foresight activity as a 'systemic inquiry' where the actual design of the system can only be partially specified in advance of system operation. This is because, when human and social systems are dealt with, the most thoughtful and carefully designed systems may have unintended consequences. System behaviour and informal structure emerge only through system operation regardless of the detail or diligence in design efforts prior to system deployment. The over-specification of a system's requirements (i) wastes limited resources, (ii) reduces system autonomy, which means the agility and flexibility of the system to respond to environmental shifts are reduced, and (iii) fails to permit subsystem elements to self-organise based on their contextual knowledge, understanding and proximity to the operating environment.

The SFM sees the design of an institutional Foresight activity as a creative process that will be engaged in designing a future system to fulfil goals and expectations. Therefore, the SFM specifies only the minimal requirements necessary to achieve the systems objectives. Thus, the SFM suggests a learning system, which structures a systems-based debate to formulate the basic processes of (1) Intelligence (scoping, surveying and scanning phase) (2) Imagination (creative and diverging phase), (3) Integration (ordering and converging phase), (4) Interpretation (strategy phase), (5) Intervention (action phase), (6) Impact (evaluation phase), and (7) Interaction (interactive and participative phase) which continues throughout activity.

The phases explain how systems such as human and social systems, industrial and sectoral systems, and innovation systems are understood, approached and intervened for a successful change process. They follow each other iteratively and can be repeated as many times until the practitioners believe that their complete function has been fulfilled. The aim is to guide practitioners to set their agendas for the different phases of the Foresight activity and to give direction to their thinking processes in order to (i) design a Foresight methodology, which fits well with the context and content of the exercise, and thus (ii) to decision making involved in thinking about the future and connecting the future with the present policies and actions.

While giving a process orientation for the design and implementation of Foresight exercises with these phases, three strands of Foresight (Miles and Keenan 2002) with three further additions are introduced, including: (i) Futures strand

[1] Forlearn Online Foresight Guide (http://forlearn.jrc.ec.europa.eu/guide/).

('when'); (ii) Capacity building strand ('who'); (iii) Strategic planning strand ('how'); (iv) Worldviews/goals strand ('why'); (v) Institutions/structures strand ('what'); and (vi) Theme strand ('which'). The six strands aim to provide an agenda for each phase of the Foresight activity.

The combination of the phases and strands constitute the conceptual framework of the SFM, which will be introduced following a brief overview of institutional Foresight as a systematic activity and the evolution of practice in time. The purpose is to demonstrate how the situations in the world have changed and how Foresight practice was adapted to address the expectations and challenges of different decades starting from the 50s. The key requirements for Foresight in the 2010s are characterised by uncertainty and complexity in the STEEPV systems with an increasing need for systemic thinking. Highlighting the need for more holistic and systemic thinking due to increasing interrelationships and interdependencies in complex systems, the paper discusses the underlying concepts of systems thinking, which will constitute the basis for the development of the SFM. The paper then will continue with the description of the SFM framework and its phases. Two case studies will be described, where the SFM was used first to give a process orientation to Foresight activities in Higher Education Institutions and then for the selection and combination of methods in a Renewable Energy exercise. The paper concludes that the SFM is a potentially useful conceptual framework when designing a Foresight exercise in complex and uncertain social and human systems.

6.2 Foresight: The Evolution of Practice

As practiced institutional Foresight is an outgrowth of a long and historic tradition of 'foresight'. Stemming from the *unavoidable human trait of thinking about the future* (Loveridge 2009) as a concept, and from planning and forecasting as a structured activity, institutional Foresight essentially implies some form of 'participative vision-based planning process'. First formal Foresight efforts existed from the sixteenth to eighteenth centuries when Foresight was used to improve decision making and public debate, and to anticipate long-term trends and long-term implications of short-term decisions. Wide array of issues were covered by those efforts, particularly after the Industrial Revolution which caused major transformations in science, technology and society and thus increased the concerns for the future. In the nineteenth century, efforts have been made to think about the future of capitalist economies. These efforts were mainly initiated by classical political economists. In the early 1900s, the principles of trend extrapolation and social indicators were established. First systematic methods of expert analysis (i.e. Delphi and Cross impact) were established around the mid-twentieth century. First computer simulation studies were well known around the same time.

During the 1950s and 1960s, which mark the post-WW2 period, Foresight was narrowed down to anticipate new technology areas. These efforts were mainly called 'forecasting' to explain that they were concerned with the 'probabilistic

assessment of what is likely to happen in the future'. Applications were seen in military and large corporations with the main focus areas on science and engineering. The work was carried out with the participation of a limited group of experts and futurologists. Creative and consultative methods like Delphi, scenarios, brainstorming and expert panels were extensively used. The work undertaken by the US Department of Defence, the US Navy and field surveys such as on astronomy and life sciences can be given as examples.

A change in the understanding of forecasting was witnessed in the early 1970s due to major crises such as the unexpected oil-shocks. Such unpredictable events caused doubts on the reliability of forecasting. Around the same time, Meadows et al.'s (1972) famous book "*Limits to Growth*" depicted the complexity and uncertainty of the world systems. Consequently, towards the end of the decade forecasting tended to be less deterministic due to a common understanding of 'the future is simply not the extension of the past. The underlying assumptions of forecasting changed that discontinuities existed. During the 1970s, efforts were made in Japan to forecast the future of Science and Technology (S&T). Conducted with the aim of informing national S&T policy, Japanese national forecasting activities incorporated economic and social needs as well as the S&T advances.

The Foresight activities in the 1980s can be characterised by the consideration of 'multiple futures' to express a wider frame of uncertainties involved in the world and society. During this time institutional Foresight was widely acclaimed by national governments as an activity associated with the identification of priorities and development of long-term S&T policies. Activities carried out in France (e.g. National Colloquium on Research & Technology) and in the Netherlands (e.g. the Foresight exercises initiated by Ministry of Education and Science) can be given as examples (see Papon 1988; van Dijk 1991).

During the 1990s, exercises have been lengthily organised and carried out by government advisory boards, research councils, national academies of sciences, other governmental departments, industrial associations and in firms. Large scale national Foresight programmes were conducted in Germany, France and the UK, which then inspired a number of other countries in Europe and around the world to start their own programmes. S&T was the central focus of those activities. Developments in S&T were seen in relation to economic and social developments. This type of Foresight exercise is defined as: *the process involved in systematically attempting to look into the longer term future of science, technology, the economy, and society with the aim of identifying areas of strategic research and the emerging new technologies likely to yield the greatest economic and social benefits* (Martin 1995).

As the complexity of societies has increased, the scope and focus of Foresight activities have widened to cover a wide variety of issues in the 2000s. Reflecting its broad focus and application areas, the recent definitions of Foresight in the 2000s emphasised more on the process of Foresight than its scope or coverage (i.e. the use of science and technology to achieve economic benefits): Foresight is *the application of 'systematic,' 'participatory,' 'future-intelligence-gathering and medium-to-*

long-term vision building process' to 'informing present-day decisions and mobilising joint actions' (Miles and Keenan 2002).

What is next? Foresight shapes the world through policy, but it is also shaped by the wider contexts and developments in these contexts. Transformations in today's society is ongoing at a higher speed due to the factors like the increasing importance of technological, organisational and social innovation; the development of service economies; and other developments such as rapid globalisation, and changing nature of demographical structures, cultural practices, environmental affairs and social services. These resulted with a world which is more interconnected, interdependent and complex than ever. Therefore, a need has occurred to improve the Foresight practice to tackle with these new situations in a more sensible way and to respond to more sustainable policy needs. Any new Foresight approach in this regard should aim for understanding these complex systems and their behaviours, thus needs to be 'systemic'. The current paper posits that the Foresight practice in the 2010s will be shaped by the notions of systems thinking. As a first step of understanding systems, the following section will discuss the underlying concepts of systems thinking, which will constitute the base for the development of a SFM.

6.3 Systems Thinking

The medieval hierarchical metaphor relating to society and the heavens was replaced by a mechanical metaphor with the rise of modern science from the 1500s to 1600s (e.g. Galileo and Newton). Science was transformed by a dramatic new idea that the rules based on mathematical equations could be used to describe the natural world. This mechanistic and reductionist principles fed the growth of the physical sciences phenomenally. In their interest for natural science, social theorists also enthusiastically adopted mechanistic model (Bausch 2002).

However, mechanistic models faced challenges when they were applied to complex problems. Thus, there occurred a need to study the interconnectedness of phenomena and the mechanisms that generate the phenomena, as well as the complex wholes with their 'emergent properties' emerging not from individual parts, but their interaction. The idea of using the concept of 'system' to understand phenomena is attributed to Ludwig von Bertalanffy's work in the late 1920s. According to Bertalanffy (1929), a singular causal analysis was no more possible when considering the complexity of the whole organism.

This gave rise to the introduction of the idea of 'systems' as an approach to deal with the complexity inherent in physical, living and social systems (Churchman 1968; Beer 1979; Ackoff 1981). Thus, the central concept of a 'system' embodies: *A set of elements connected together which form a whole, this showing the properties which are properties of the whole, rather than properties of its component parts* (Checkland 1981).

Stemming from this definition, 'systems thinking' is about viewing 'events' as a system and/or parts of larger systems. Systems thinking inherited a set of powerful

systems ideas such as 'system', 'element', 'relationship', 'input', 'output', 'boundary', 'feedback', and 'communication'. These ideas led to the development of the basic features of systems thinking including: (i) Causality, (ii) Holism, (iii) Hierarchy, and (iv) Continuity. Systems approaches and methodologies have been built upon these concepts. Therefore, it is useful to give a brief definition of each.

Causality. Represents the effect of one or more system elements on the properties or the behavious of the other(s). It is embodied through communication among system elements via 'feed-back' and 'feed-forward' channels (Kay et al. 1999; Hammond 2002). The communication among system elements is due to the reason that they are (1) interrelated, and (2) interdependent (Modarres and Cheon 1999). Interrelatedness explains the connections between the elements of the system and implies that the system taken as a whole has properties that differ from those of the simple sum of the effects of the individual relationships between the pairs of elements. Interdependency is more specific and is the way the relationships are conducted. The properties and behaviour of each system element and the way they affect the whole, depend on the properties and behaviour of at least one other element in the set. This advocates holism in systems thinking.

Holism. One of the key features of systems thinking is the claim that it is holistic, giving three messages: (i) the whole is more than the sum of its parts, (ii) the parts cannot be considered in isolation from the whole, and (iii) the behaviour of the system cannot be understood independent from its context.

Hierarchy. Hierarchy explains the grouping or arrangement of system according to their higher and lower influence and coverage levels (e.g. upper level systems and sub-systems or nested systems). Hierarchy emerges naturally in all evolving systems (Simon 1962). This is because, systems exist as parts of larger wholes, while they themselves provide organisation to their sub-systems (Koestler 1967; Churchman 1968). A system hierarchy may not always indicate well defined conceptual boundaries, particularly in complex systems where the relationships are not simple or complicated. This holds true both for present and future systems, which the FTA is concerned with.

Continuity. Systems thinking recognises that systems transform themselves continuously, and therefore are dynamic. Thus, continuity in systems explains an iterative, dynamic and non-linear process. In systems terms, two types of continuity can be mentioned (i) the continuity of a looped action sequence, and (ii) the recursion of the looped action sequence in time. The first type of continuity can be best represented with Argyris and Schon's (1978) 'single-loop' and 'double-loop' learning systems. During these loops a system reproduces a continually changed self (Argyyis 1976; Argyyis and Schon 1978). The recursion of the looped action sequence in time brings the second type of continuity. Vickers's (1965) "Appreciative System" can be given as an example to demonstrate this type of continuity, where the flux of events and ideas in time generate a new appreciation, and appreciation itself leads to action while improving standards and norms.

A number of different systems can be mentioned including 'closed' and 'open' systems. Various systems approaches have been suggested to deal with those systems like 'hard' or 'functionalist' systems approach (Churchman et al. 1957);

'soft' or 'interpretive' systems approach (Checkland 1981); and a more recent addition 'emancipatory' or 'radical' systems approach (Jackson 2001). These approaches have all been built upon the basic features of systems thinking. They suggest various ways of understanding and solving the problems in either mechanical or social systems.

The dominant systems thinking of the post-WW2 period evolved in the context of mechanistic thinking. This understanding was based on a body of well-developed and tested theory stemming from engineering systems. It was assumed that systems of all types could be identified by empirical observation of the reality and could be analysed by the same approaches which had brought success in natural sciences. Supporting one single perspective of the reality, it was assumed that systems were the 'objective' aspects of reality, which could be represented equally by different observers. The components of the system were considered to have clear causal interconnections and relationships between them. The functionalist approaches have seen successful applications in 'bounded' situations, where the components of the system behave in a manner that is nearly optimal with respect to its goals and resources (Simon 1957, 1962). However, this type of approach can only cope with low human complexity and low to medium divergence of interests.

The interpretive (soft) allows a greater responsiveness to the peculiarities of each situation. Thus, the intervention to systems evolves as the situation changes. Therefore, it can be said that a system is defined for a particular situation given. The interpretive approach accepts that human and social systems cannot, in principal, be explained in a purely functional way. In the interpretive approach, the definition of a system reflects the observer's world view. Therefore, there is a subjectivist view of systems, which means that no assumption is made to represent the system as it is in reality. Rather, it is seen as a conceptualisation of what the observer views as a useful and convenient representation of elements and interrelationships in view of learning more about the behaviour of a system.

Like the interpretive approach, the emancipatory systems approach takes a subjectivist view of systems. The emancipatory approach has evolved in response to challenges imposed by complexities of socio-cultural systems in 'radical' cases where, for example, conflicts and unequal power distribution occur. The basic idea of emancipatory approach lies in its thinking that various stakeholders in society may see systems radically different with different values and boundary judgements. The radical view accepts that these stakeholders may be in conflict of confrontational relationship with each other and may be unequal in terms of their power. Thus, the emancipatory approach aims to identify inequalities and promote radical changes.

The nature of the situations under investigation determines the kind of system approach to be used for understanding and intervention.

6.4 Systemic Foresight Methodology (SFM)

6.4.1 Background of the SFM

The review of literature and the evaluation of current Foresight practice reveal that there is a great potential that systems thinking might assuage the Foresight practice when dealing with complex social and human systems and situations involved in them. With its basic features outlined above, systems thinking recognises complexity and uncertainty involved both in real world systems (physical and social) and in idea creation, while attempting to propose actions within either bounded or open systems. If institutional Foresight acknowledges the importance of '**causality**', then it would be possible to understand how system elements affect the properties or the behaviours of other system elements and thus the behaviour of the whole system. Understanding the interrelationships and interdependencies is necessary for the discussion and definition of system boundaries, which is one of the most crucial phases of Foresight.

Consideration on the relationships between and within systems turns attentions from individual system elements to the wholes. With the adoption of the '**holistic**' thinking, the SFM pays attention to the forces outside, which may have impacts on the viability and success of the system under investigation. Thus, decisions taken will be better prepared against the influences originating from the wider context. Similarly, the decision makers will appreciate the impacts of their decisions on wider social and environmental systems. Foresight focuses on the systems or bits of them which can have strong potentials to change or transform the wider systems.

Understanding the '**hierarchy**' of systems provides structural and functional boundaries for Foresight. Structurally, attentions are turned to the description of the system, its parts and other higher and lower level systems, their arrangements and interactions. This would allow Foresight to facilitate communication and information flow via feed-back and feed-forward mechanisms, which will allow: (i) to provide continuous adaptation of the Foresight system to changing internal and external conditions, and (ii) to secure improvement and further development while providing for maintenance of stability. Furthermore, the understanding the functional hierarchy will bridge the principle purpose of doing Foresight with the activities carried out throughout the exercise. From this viewpoint, activities can be considered as the functions and sub-functions of the overall objectives. The realisation of functions and sub-functions will assure that the objectives of Foresight are achieved. Having this viewpoint, the systemic approach will enable the integration of 'ends' (what is wanted) and 'means' (how to get there) of the Foresight activity.

Systems thinking recognises that systems transform themselves continuously and therefore are dynamic. This implies a dynamic and non-linear process for Foresight. **'Continuity'** for Foresight first means that the process flows from understanding to anticipation and then to transformation, and the recurrence of this process in a looped manner. This continuous looped action sequence in time

brings the second type of continuity. Here the Foresight system learns, evolves and intervenes into situations through the modification of norms, policies and objectives.

Having set its underlying assumptions, the SFM claims that a robust Foresight exercise involves a continuous interplay between the context, content and process of change together with skills in regulating the relations between the three (Fig. 6.2). Any change activity, like Foresight, should be linked to a broader context. The lack of attention away from the context leaves the critical issues unrecognised. Thus, Foresight should not strive to understand the issues as episodes divorced from the historical, organisational and/or economic systems from which they emerge. Three important points can be specified for further examination of the context of Foresight:

1. The need to gain a rich understanding of existing systems and procedures, their history and possible futures
2. The analysis of different stakeholder perspectives and their social relations in the system, which can affect and be affected by the process
3. The impacts of formal and informal networks and procedures, which can be in favour or in conflict with other systems

Considering the nature of the Foresight activity, two context levels can be distinguished: (1) External context, and (2) Internal context. Foresight is embedded in these two contexts which produce and are produced by the activity. The Foresight activity is then about perceiving the context through a holistic scanning exercise; capturing the points of intervention, which constitute the content of the change programme; and anticipating, and developing future-oriented policies and strategies on this content through a designed process. Thus the overall SFM can be represented as follows (Fig. 6.1):

The Social, Technological, Economic, Environmental, Political, and Value (STEEPV) systems constitute the external context, where the Foresight activity is embedded in and thus is influenced by the factors in them. Foresight aims for improving or changing one or more parts of these systems. The content, or agenda, of the Foresight exercise is extracted from the STEEPV systems, which are interrelated and interdependent and constitute the real world situations. Loveridge and Saritas (2009) have formulated three questions to be asked as a starting point to investigate into those situations (Fig. 6.2).

The contents of the first two questions are recognised in the context of science (possible) and technology (feasible). However, both have added contexts and contents that extend into the third question of desirability where the social, political and value contexts intersect with the two questions in interdependencies of governance, regulation, precaution, social acceptance and policy.

Besides understanding the external context, it is also essential to investigate on the internal context, which can be considered as a filtering factor when the external context is viewed and appreciated and the content of the Foresight activity is built. The internal context relates to the structures (e.g. internal processes, procedures, equipment and technologies) and behaviours (e.g. culture, politics, social

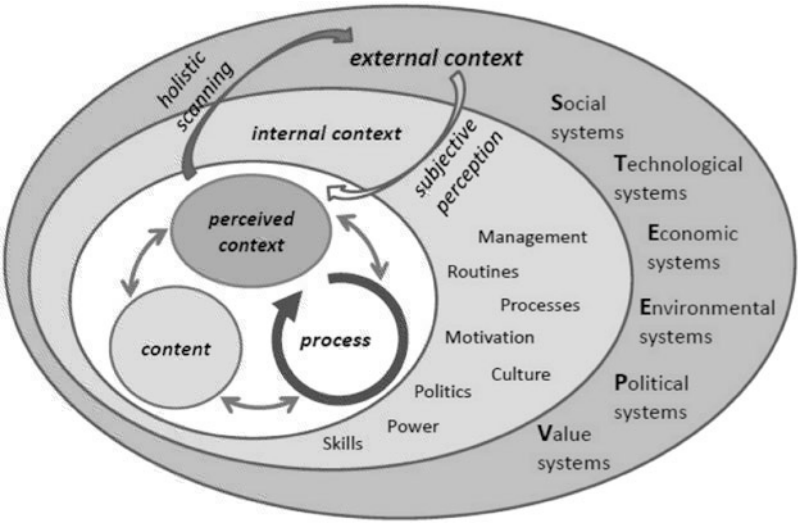

Fig. 6.1 Systemic Foresight concept

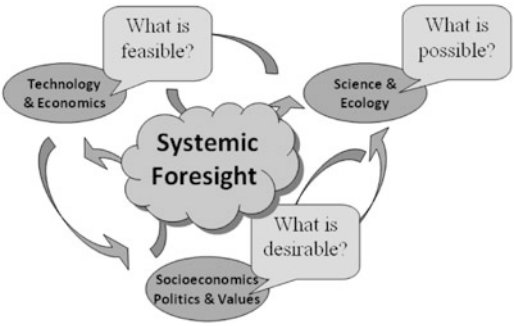

Fig. 6.2 Questions for systemic Foresight

interaction, skills, motivation, power and management styles) within the context of the organisation where institutional Foresight is organised and carried out. The internal context covers all parties involved in designing, organising and deploying the Foresight activity. The success of the activity is dependent on a large extent on these parties and their motivation and expertise in field.

In Foresight, the 'what' of change is encapsulated under the label of content, which refers to (1) the subject area(s) taken into consideration, which are captured from the context through scanning, and (2) the ideas created related to those areas during the Foresight activity. The main goal of Foresight in this sense is to introduce change or improvements into the content of the exercise and thus to provide further changes or improvements in the context.

6.4.1.1 Behavioural Matters in Foresight

Foresight creates information for the future of society under uncertainty and complexity. It is expected to place greater emphasis on the need for the active participation by a balanced but wide spread of stakeholders who, through involvement in decision making and behavioural matters will help to shape the future of society, in this way distinguishing the proposals from other future oriented policy making tools. Changing scope and focus of Foresight requires the activity to be enabled a much wider cross section of people to take part. In order to achieve this inclusivity, the organisers of the activities need to put much effort into understanding these behavioural matters. The SFM also considers the behavioural matters and recognizes their pervasive influence throughout all Foresight process. Behavioural matters are inherent both in systems and in the Foresight process itself.

The notion of 'open' system comes from the unpredictability of the behaviours of the system elements. In this respect, systems, particularly human and social systems, behave differently both spatially and in time under different circumstances. Therefore, systemic investigations require specific approaches, which are developed following an 'understanding' phase.

The Foresight process itself is 'soft' and 'open' due to the inclusivity of various actors and stakeholders in the process with different perceptions, worldviews and visions. *Inclusivity is a matter of creating trust across a wide range of communities in discussions of future developments (. . .). The objective ought to be to enable the participation of a broad spectrum of people who are concerned about the feasibility of technological developments and their desirability. To introduce inclusiveness will require a change in mind-set by programme sponsors, organisers, practitioners, the direct participants and the audience to whom the outcome is directed. Indeed, the process has to be one in which experts and non-experts regard each other as equal but different agendas and capabilities that each needs to understand. Bringing this mutual appreciation about will test communication and interpersonal social skills to their limit. In this sense inclusiveness is a matter of definition and process. Extending participation introduces specific management and process needs if Foresight programmes are to be extended into the social sphere without becoming chaotic* (Loveridge and Saritas 2009).

Understanding the behavioural matters in Foresight would lead to a more dynamic and adaptive way of conducting the activity. During the process of Foresight, the organisers and participants of the activity should be seen not only as the technical experts, but also as the key agents of social and organisational change. Transformation of a system from its present state to a more desirable future state requires actions to change the individual and organisational behaviours. The role of behavioural matters in Foresight will be discussed with the case of the Higher Education Foresight case, which will be presented in the next sections of the paper following the description of the phases of the SFM.

6.4.2 The Phases of the SFM

The SFM sets out to create systemic concepts that are useable for future-oriented idea creation in complex human and social systems. The SFM considers the Foresight activity as a 'systemic inquiry' where the actual design of the system can only be partially specified in advance of system operation. This is because, when human and social systems are dealt with, the most thoughtful and carefully designed systems may have unintended consequences. System behaviour and informal structure emerge only through system operation regardless of the detail or diligence in design efforts prior to system deployment.

The SFM considers the design of an institutional Foresight activity as a creative process that will be engaged in designing a future system to fulfil goals and expectations. Therefore, the SFM specifies only the minimal requirements necessary to achieve the systems objectives. Thus, the SFM suggests a learning system, which structures a systems-based debate to formulate the basic phases of: (1) Intelligence, (2) Imagination, (3) Integration, (4) Interpretation, (5) Intervention, (6) Impact, and (7) Interaction. These phases aim at guiding Foresight practitioners to set their agendas for the different phases of the Foresight activity and to give direction to their thinking processes. The benefits of this approach lies in its systemic guiding (1) to the design of a Foresight methodology, which fits well with the context and content of the exercise, and thus (2) to decision making involved in thinking about the future and connecting the future with the present.

The consecutive phases explain how systems such as human and social systems, industrial and sectoral systems, and innovation systems are understood, approached and intervened for a successful change process. They follow each other, as the steps of the Foresight process, but they are iterative and can be repeated as many times until the practitioners believe that their complete function has been fulfilled.

The SFM is suggested as a conceptual base for the design, organization and deployment of Foresight exercises. Methods are not the departure points of the SFM approach. They are used to support and develop understanding of the situations, to discuss and develop alternative models of the future and achieve outcomes through networking, mutual learning and collective visioning, and outputs in the form of policies and strategies. Methods are selected and integrated following a comprehensive 'understanding' exercise. In this way, methodological solutions are produced after the diagnosis and conceptualisation of situations. Figure 6.3 illustrates the phases of the SFM.

6.4.2.1 Intelligence (Scoping Phase: Surveying, Scanning, Evidence)

Intelligence is the first and fundamental step of the SFM. Foresight deals with are usually complex systems, which consist of a large number of interacting elements (Roe 1998). According to Roe, the appropriate approach to complexity is to embrace it and resulting uncertainty and to analyse different subsets of interactions

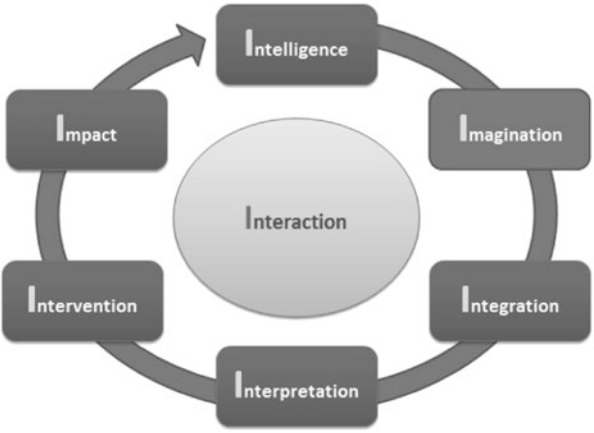

Fig. 6.3 Phases of the Systemic Foresight Methodology

which may be relevant from a number of fundamentally different operational and philosophical perspectives.

Holling (2000) and Gunderson and Holling (2001) suggest alternative ways of dealing with complexity. Holling (2001) states that *the complexity of living systems of people and nature emerges not from a random association of a large number of interacting factors rather from a smaller number of controlling processes. These systems are self-organised, and a small set of critical processes create and maintain this self-organisation (. . .) There is a requisite level of simplicity behind the complexity that, if defined, can lead to an understanding that is rigorously developed but can be communicated lucidly* (p. 390). Whatever way of understanding the complexity is adopted, when the complex systems are examined, the following criteria suggested by Holling (2001) should be satisfied:

- Be "as simple as possible but no simpler (Einstein)" than is required for understanding and communication
- Be dynamic and prescriptive, not static and descriptive. Monitoring of the present and past is static unless it connects to policies and actions and to the evaluation of different futures
- Embrace uncertainty and unpredictability. Surprise and structural change are inevitable in systems of people and nature (p. 391)

As the first phase of the systemic process of inquiry, the Intelligence phase begins with a comprehensive understanding and scanning exercise, which provides input for the overall activity. Understanding seeks to attain a reasonably comprehensive view of situations involved in the STEEPV systems. The aim is to gain a shared understanding and mutual appreciation of situations, issues, and influencing factors as systems within their own contexts by uncovering uncertainties about the values and preferences of actors and stakeholders, and clarifying the goals of the entire activity. In this way, the SFM offers a mind-set for understanding how systems work and behave. The aim is not necessarily to bring about a convergence

of views, but, at least a partial convergence is likely to emerge from this process in practice.

As an integral part of the Intelligence phase, scanning provides basic input to the entire activity. Overall, scanning is concerned with the systematic examination of potential threats, opportunities and likely future developments, which are at the margins of current thinking and planning (DEFRA 2002). Selecting the main areas for intervention, the boundaries of the Foresight are drawn and the 'content' of Foresight is built through an initial scanning activity. Various quantitative and qualitative Foresight methods can be used to create input at this phase including horizon scanning, bibliometrics, literature review, and analysis of trends, drivers, weak signals, wild cards/shocks/surprises, and discontinuities (Saritas and Smith 2011).

As a result of this process, the initial boundaries of the system under investigation can be drawn and the content of change can be defined by capturing the key drivers of change, and other factors which may have strong potential impacts on the future of the systems under investigation.

6.4.2.2 Imagination (Creative Phase: Concepts, Models, Scenarios, Visions)

The input gained from the Intelligence phase is synthesized around the models of the situations involved in the real world. These are conceptual models to a large extent which are shaped by the subjective perceptions of the observers involved in the activity. The aim is not to obtain the true representations of the situations, but to achieve agreeable and workable models, which should be able to represent:

- Wealth of a system: The inherent potential of a system that is available for change, since that potential determines the range of future options possible. Wealth or potential of a system sets limits for what is possible and determines the number of alternative options for the future
- Controllability of a system: A measure that reflects the degree of flexibility of the rigidity of a system. It determines the degree to which a system can control its destiny
- Adaptive capacity: The resilience of a system as a measure of its vulnerability to unexpected and unpredictable shocks

The boundaries of the Foresight activity are finalised based on the modelling exercise. The next step is then the development of future models to explore alternative images of the future based on anticipation. These models will cover a range of possible, plausible and desirable future systems. Independent from existing systems and their influence, fundamentally new systems can be suggested with the involvement of high level of creativity. New actors and stakeholders can be brought in, existing ones can be removed, and/or new roles can be suggested for them. Similarly, new relationships between the system elements can be established and existing ones can be modified and/or removed. The overall aim is to create a desirable future system.

Visual representation tools are very valuable to understand systems, their elements and the relationships between them. Systemic models represented can portray how the impacts of trends and emerging issues move inward and outward, and influence the structure, behaviours, opportunities and constraints. These models lead to the creation of various alternative scenarios for the future. Modelling, Scenario planning, Gaming and Simulation are the methods which may be of help to explore alternative futures. The analysis of Weak Signals and Wild Cards may help to test the adaptive capacity of systems under extreme conditions, and surprises. The Imagination phase involves high level of creativity and innovative thinking.

6.4.2.3 Integration (Ordering Phase: Analysis, Negotiations, Priorities)

Following the construction of alternative models of the future in the Imagination phase, the Integration phase is concerned with the systemic analysis of those alternatives and selecting the most desirable one. The analysis and selection of a desired system is multifaceted as there is a variety of worldviews and expectations to be negotiated. According to Ackoff (1981), for a system to be viable in the long term, the claims of different stakeholders must be considered adequately, and therefore, attention must be given to ethical and aesthetic aspects for the pursuit of ideals such as beauty, truth, good and plenty. Therefore, there is a strong element of negotiations involved to determine priorities in the light of an agreed vision.

During this process, decisions on the desired future system need to be aligned with the normative goals and values. An inclusive process, where the creative exchange of ideas and information sharing among participants is experienced, is beneficial. The definition of the 'most desirable' future system is a matter of 'prioritisation'. The end product of this phase is an agreed model of the future. Methods like Delphi, Cross Impact Analysis, Multi-Criteria Analysis, SWOT and/or Cost/Benefit/Risk analysis can be considered among the methods to support this process.

6.4.2.4 Interpretation (Strategy Phase: Agendas, Strategies)

Following the decision on the most desirable/preferable future, this phase aims to connect this future with the present and sets out agendas and strategies for action. Thus, the Interpretation phase establishes the relationship between the future and the present for a successful change programme. The transformation from the present system to a desirable future system requires strategic level decisions to be taken such as on: (i) skills and educational systems needed; (ii) awareness of market and social demands for innovations; (iii) public acceptability of particular lines of advance, (iv) scope for formation and growth of firms, and (iv) financial institutions and incentives.

Due to the systemic relationships between these elements, the transformation process needs to bring a broad range of STEEPV factors together. The following factors constitute conditions for the successful transformation strategies:

- Assessment (e.g. processing information; developing an understanding of the continuously changing context; and becoming an open learning system)
- Leadership (e.g. having a context-sensitive leadership; creating capabilities for change; linking actions with resources; and constructing a climate for change)
- Linking strategic and operational change (e.g. supplying visions, values and directions; implementing intentions over time; and implementing supportive activities)
- Management of human resources (e.g. raising human resource management consciousness; demonstrating the need for change in people and behaviours; creating a longer term learning process with successive positive spirals of development)
- Coherence (e.g. achieving the consistency of goals, creating an adaptive response to environment; and maintaining competitive advantage)

A backcasting or roadmapping procedure would be beneficial to define the steps of the transformation process in the long, medium and short run.

6.4.2.5 Intervention (Action Phase: Plans, Policies, Actions)

Any Foresight exercise has to inform policies and actions. Therefore the main action of the Intervention phase is action with the main activities involving the creation of plans, policies and actions to inform present day decisions concerning immediate change actions to implement structural and behavioural transformations. Actions suggested at this phase aim to give messages on the first and most immediate interventions to the existing systems. Operational level questions are asked for actions such as: 'what and how', 'where and how' and 'who and how'. The actions for change are determined by considering the following capabilities of the system under investigation: (i) Adapting; (ii) Influencing and shaping its context; (iii) Finding a new milieu or modelling itself virtuously in its context; and (iv) Adding value to the viability and development of wider wholes in which it is embedded. Action plans, Operational plans, Priority lists, Critical/key technologies can be among the outputs produced at this phase.

6.4.2.6 Impact (Evaluation Phase)

Foresight process requires substantive investments, often through public funding, and imply considerable costs in terms of time and expertise invested. If impacts of Foresight cannot be made clear, the commitment for investing resources will decrease, and as a result the activity will be discontinued. Therefore, an Impact phase is added to the process, which is concerned with the review, evaluation and

renewal of the Foresight exercise. This phase will examine the impacts during the process (e.g. production of baseline reports, articulation of visions, and building new linkages), immediately after (e.g. new integrated projects and programmes) and sometime later (e.g. innovation impacts and new working communities).

The impacts of Foresight should be kept in mind from the beginning of the Foresight process, and the methodology should be designed to achieve those impacts. An effective communication strategy is essential during and after the Foresight process for assisting the participants and target audience in making sense of the results. Impacts of are measured through an evaluation exercise, which is commonly conducted based on three criteria including (i) appropriateness of objectives and methodology; (ii) efficiency of implementation with a focus on management and organisational processes, and appropriate use of funds; and (iii) impact and effectiveness through the recognition of the results, creation of a Foresight culture and new combinations of stakeholders and networks. Although the Impact phase can be considered as the final phase of the process, there is a strong learning element involved in this process, which determines how to design and implement and better Foresight exercise. Thus, it can also be considered as a beginning of the next cycle of Foresight.

6.4.2.7 Interaction (Participative and Interactive Phase)

Foresight is an inclusive activity. Interaction with the systematic involvement of stakeholders in an inclusive process with long-term perspective for the analysis of different perspectives and their social relations in the system are crucial for the Foresight process. The SFM recognises the inclusiveness and equity through freedom of association and expression and the role of the democratic society, which may influence, restrain or block policy design and implementation. The Interaction phase emphasises the need for effectiveness and efficiency in meeting society's expectations and sustainable use of resources, and therefore, aims to develop mechanisms to provide contributions of society, institutions, corporations, and associations to enhance policy with a normative and legal framework.

All phases of the SFM described above are systemically interrelated. Each of them builds on the previous one, culminating in policies, strategies and actions for the design of a future system. However, information and action flow between the phases are not necessarily in a linear way, but from one to the others in a systemic way. Each phase can be iterated more than once until the outputs and process outcomes planned are achieved. Upon completion of the process the phases link back to create a full circle of Foresight in a continuous loop (Fig. 6.1) in a similar stance with Vickers's (1965) "Appreciative System" and Argyris and Schon's (1978) double-loop learning. This allows the continuous development and adaptation of systems. It is important to highlight that the process of Foresight is just as important as the end-product, and that the commitment to the process by participants is essential if the policies and strategies are to be successfully implemented.

In order to assist practitioners to build an agenda for each phase, the six strands of Foresight are introduced:

1. Futures strand ('when'): systematic exploration of trends, projections, scenarios, wild cards, and policy responses
2. Capacity building strand ('who'): a systematic development of shared learning, networking, collaboration and intelligence between stakeholders involved
3. Strategic planning strand ('how'): a systematic application to longer term policy, in the context of uncertainty, complexity and controversy of the issue – along with the following three further strands:
4. Worldviews/goals strand ('why'): the worldviews, values ad discourses between different stakeholders
5. Institutions/structures strand ('what'): factors in the institutions or structures related to the way systems are organised
6. Theme strand ('which'): specific areas in sectors or technologies as the focus of enquiry

First three have been suggested by Miles and Keenan (2002). Three more strands have been added to allow fuller information gathering and action planning. The SFM brings together the phases with the six strands of Foresight (Fig. 6.4).

The phases of Foresight provide a process orientation of the activity, while the strands of Foresight set out agenda for each phase.

6.4.3 The Use of Methods in the Systemic Foresight Methodology

The systemic process described above does not take the methods as a starting point, as the methods need to be regarded as process and decision aids ('means'), not as the overall aim of the exercise in themselves ('ends'). Strengthened by the ideas of systems thinking, the SFM views Foresight methods as the tools to be used as part of the means to explore ideas, acquire information and data, clarify situations and negotiate solutions. Foresight is suggested to be not only a methodologically 'systematic' activity, but an activity, which creates its own methodological approaches with the consideration of the nature of the issue at hand and its context. It is due to, first, the peculiarities of each situation and, second, the subjective interpretation of those peculiarities, the SFM does not attempt to impose any methods from the earlier phases of the systemic inquiry. Instead of putting the methods at the forefront of investigation, the SFM suggests a more conceptual and flexible 'process orientation', which starts with a comprehensive 'understanding' of situations. Methods will be used, modified or tailored whenever needed. Furthermore, new methods will be created to handle the unique requirements of systems under investigation. While doing this, the SFM benefits from a pool of available foresight and forecasting methods and other planning and policy tools. It is

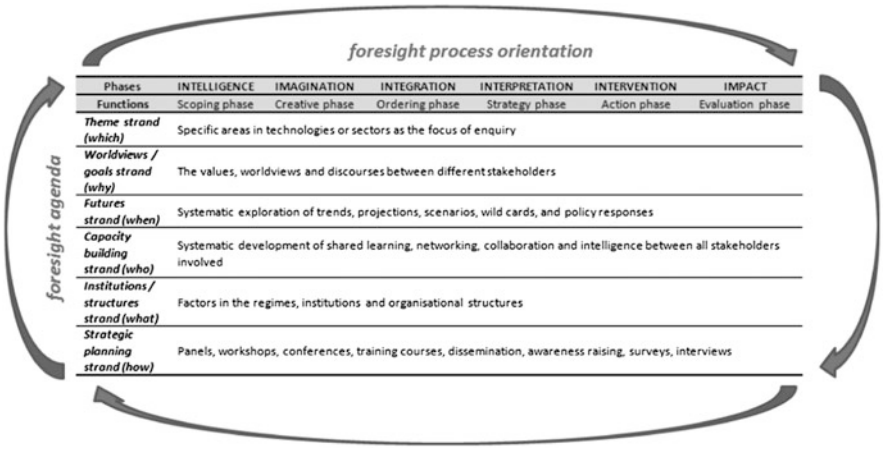

Fig. 6.4 Architecture of the Systemic Foresight Methodology

considered to be useful, particularly for the practitioners, to specify various methods, which might be of use for each phase of the Foresight process (Fig. 6.5).

Each column in the figure indicates a phase of the systemic foresight process with their functions and key activities involved. The selection and integration of methods in the list are done under the guidance of the phases with a close interaction with the context, where the Foresight activity takes place and is expected to improve. Ranging from divergent and more creative methods to convergent and more quantitative, all methods involve a certain degree of information input, creativity, expertise and participation. The methods given in the table are indicative and the list can be extended with other methods given that they fulfil the functions of different phases described above. It is important to note that the use of the methods will also be determined by available resources including expertise, skills, time and budget along with the level and type of participation required.

6.5 SFM in Practice: Two Case Examples

The SFM described in this paper has been applied fully or partially in various Foresight exercises in different contexts. This section will describe two cases. The first case is about the implementation of the SFM in two university departments to first to develop visions and then formulate research and teaching strategy. In this case, the SFM is used to provide a process orientation to the overall Foresight activity. Two parallel cases, which started at the same time, highlight the soft and evolutionary nature of the Foresight process and emphasises the relationship between the context, content and process of Foresight. Both Foresight exercises resulted with different processes and methodologies. The reasons for this will be discussed from the SFM viewpoint. The second case briefly demonstrates how a

Phases	INTELLIGENCE	IMAGINATION	INTEGRATION	INTERPRETATION	INTERVENTION	IMPACT
Functions	Scoping / surveying	Creative phase	Ordering phase	Strategy phase	Action phase	Evaluation phase
Activities	Survey, scan, evidence	Concept model, visions, scenarios	Priorities, analysis, negotiations	Agendas, strategies	Plans, policies, actions	Review, revision, renewal
Divergent Methods (more open, creative)	Horizon scanning	Scenario stories / images	Backcasting	SWOT analysis	Communication planning	Interview
	Social Network Analysis	Gaming	Delphi	Strategic planning	R&D planning	Policy review
	Knowledge / research map	Visioning	Success scenarios	Roadmapping	Operational research	Impact indicator development
	Literature review	Agent –based modelling	Multi-criteria analysis	Cross-impact analysis	Action planning	Policy impact assessment
Convergent methods (more specific, quantitative)	STI policy analysis	Scenario modelling	Risk assessment	Logic framework	Critical / key technologies	Survey
	Text/data mining & patent analysis	System dynamics	Cost-benefit analysis	Linear programming	Priority lists	Bibliometric analysis
INTERACTION	Panels, workshops, conferences, training courses, dissemination, awareness raising, surveys, interviews					

Fig. 6.5 Classification of Foresight methods

methodological approach was developed for a Regional Foresight exercise on Renewable Energies in Berlin-Brandenburg in the context of the EU-funded "Benchmarking and Foresight for Regions of Europe (BEFORE)" project (Selecting and combining methods with the use of the SFM framework). This case describes how the SFM was used to combine quantitative and qualitative methods in line with the objectives, context, content of the Foresight exercise under resource limitations. The impact phase of the SFM process is not demonstrated, as the cases have not been evaluated.

6.5.1 Systemic Foresight in Higher Education Institutions

Two Systemic Foresight exercises were designed, organized and implemented in order to demonstrate the first applications of the SFM. For this purpose, two academic departments, the Department of Project and Construction Management in Istanbul Technical University (PYY), and the Department of Civil Engineering in Bogazici University (BUIM), were selected as host organizations. Thus, two institutional Foresight exercises took place in two different organizational settings with the participation of two different groups simultaneously. The involvement of two contextually different organizations in parallel was a unique opportunity to test the SFM and see how the interaction of different contexts, contents and processes would give rise to different practices and outcomes.

6.5.1.1 The Process

A Foresight process was designed with the use of the SFM framework. Being the integral parts of the projects, the phases gave to the activities by defining minimal requirements for the systemic process of inquiry. In addition, an introduction phase was added, which aimed at introducing the activity, presenting the methodology, and clarifying the goals. Thus, the phases of projects consisted of:

1. Project proposal and definition of goals (Introduction)
2. Systems, elements and relationships (Intelligence)
3. Construction2023[2] (Imagination)
4. PYY/BUIM2023 visions and priorities (Integration)
5. Road mapping (Interpretation)
6. Research and Development, and Education and Training strategies (Intervention)

As the projects moved forward, the actual project process was elaborated through the interaction among the context, content and process.

Project Proposal and Definition of the Project Goals

This phase aimed to promote Foresight with a presentation and form commitment via group decisions on the project goals. Having the contributions of the project participants in the definition of the goals helped to provide the commitment needed. In the end of phase 1, both PYY and BUIM established a set of project goals in order to develop their visions as academic institutions including:

1. Thinking about the long term future in a holistic manner, and
2. Developing future visions for the construction industry and for their departments, with
3. A wide participation, to
4. Identify the future R&D and T&E areas, and to
5. Develop research and teaching policies and strategies for long, medium and short terms

Intelligence: Understanding Systems, Elements and Relationships

Understanding and appreciation of the systems were seen as imperative. Intelligence gathering aimed to attain a reasonably comprehensive view of the issues within its wider context in order to gain a shared and mutual understanding of the systems. Thus, **this** phase:

[2] The year 2023 was determined based on the considerations on the nature of the construction sector, where disruptive changes are not usually introduced earlier than 20 years.

1. Applied the basic principles of systems thinking on the academic units' own organizational settings
2. Widened the participants' views on the system by helping them to understand the system that they operate in
3. Helped to appreciate the hierarchy of systems and understanding the higher and lower level systems and the relationships between them
4. Focused on departmental systems and on the external systems. Considered not only on the relationships between departments and other systems, but also on the interrelationships between other external systems
5. Provided understanding on how different systems interact and affect each other by analysing the relationships between them

Imagination: Modelling Construction 2023

This phase aimed at exploring, designing and integrating alternative systems. Considering the systems in the construction sector and relationships between them, the aim was to initiate a dialogue on the future of the construction sector. Besides exploring alternative futures for the construction industry, this phase also gave 'visionary messages' to PYY/BUIM from a wide variety of stakeholders. The visionary messages carried clues on: (1) The general future orientation of the department in the light of the developments in the sector; (2) Possible areas for R&D; and (3) Relevant education and training (E&T) areas.

Integration: Analysis and Vision Building

In the scope of the outcomes of the previous phases, including the systems and the possible and desired futures for the construction industry, the aim at this phase was to open a discussion on the future of the departments and to explore alternative futures for PYY and BUIM. Following the production of the models of the future, this phase was concerned with the analysis of alternative systems and the decision on the most desirable future system that PYY and BUIM preferred to create and be a part of in the construction sector.

Interpretation: Transformation

With the aim of transforming the present system to a desired future system, this phase defined a relationship between future and present focusing on the overall change of the existing system. In both PYY2023 and BUIM2023 exercises, the kind of structural and behavioral changes needed were identified and planned at this phase. In this transformation process, Normative, Strategic and Operational level decisions were made on the future Research and Development (R&D) and

Education and Training (E&T) areas, the need for new research and teaching staff, and infrastructural needs.

Intervention: Actions

This phase was concerned with the creation of action plans to inform present day decisions for the initial interventions to the existing system. In light of the decisions taken in this phase regarding the medium and short term future, the departments were asked to come up with a 'to do list' for present. This was a tactical document for PYY and BUIM where the members of PYY and BUIM identified actions to be taken at the operational level.

The methodologically systemic exercises aimed at creating ideas which were not fragmented and disconnected. The focus was given to wider systems in a holistic manner. The methods applied were not imposed instead they were used and developed during the course of the exercises (e.g. methods on Value System, Systems-Actors, Systems-Success Factors, Baseline Scenario Systems). Some common methods were also adopted with a systemic perspective such as integrated scenarios produced from the earlier methods designed. The framework of the integrated scenario was based on the transformations of the goals, behaviors and structures over long, medium and short terms. The same structure was used in a survey, Construction2023, which aimed to collect the ideas of stakeholders on the future of the construction industry.

6.5.1.2 The Outcomes

The outcomes of the PYY2023 and BUIM2023 Systemic Foresight exercises included:

– **Future directions for PYY and BUIM:**

- **Broad strategies and issues** that raise points of leverage, priority lists with detailed action plans for the implementation of the strategy
- **Thematic strategies for new areas of research and new research in established areas** specifying where PYY and BUIM should make research applications relevant to the long, medium and short term future
- A program, which forms a coherent pool of themes suitable for creating **new topics for Ph.D. and M.Sc. theses and dissertations** allowing PYY and BUIM to benefit from their current and future graduate students contributions to the research topics identified at the departmental level and research theme level for the next 15–20 years.
- **New courses, teaching methods and media:** New courses were identified for the next 5-10-15 and 20 years. The R&D areas were also considered to be potential areas for E&T. Along with the content; ideas were developed to use novel teaching methods and media. Necessary modifications of existing

graduate and undergraduate curricula in light of identified E&T areas were defined.

– **Strategy for human resources:** From the systemic Foresight process, PYY and BUIM gained knowledge of their current potentials with all their research and teaching human resources, their areas of interest and the infrastructure of the departments including:

  - **Improved allocation of research and teaching potential:** After the exercises, the departments knew which staff members are interested in the identified research and teaching areas now and in short, medium and long term future
  - **Recruitment:** Knowing the research and teaching potential and the future R&D and E&T areas, the departments decided on the profile of the research and teaching staff required and when they are needed. For instance, PYY now knows that researchers working on 'the use of remote sensing in construction' might be needed around 2012–2015, since this topic has been higher on the agenda recently. This also means that PYY should select graduate students willing to work in this field immediately to produce potential researchers by 2015.
  - **New infrastructure needed:** Knowing the human resources needed for the future, the departments determined their infrastructural needs, which could come into existence in the following years in relation to the allocation of its budget
  - **Collaborations:** PYY and BUIM became clearer with whom to collaborate. By showing the other relevant systems, the systemic Foresight exercises helped the departments to identify the actors to take collaborative actions in the future including other academic institutions, public and private sector organizations, and NGOs
  - **Knowing themselves:** The systemic Foresight process opened new communication channels between the members of the departments who usually have limited interaction during the problem-driven departmental meetings and who do not know actually who does what, and who wants to do what in the future

Besides these commonalities, both exercises involved substantial differences in terms of processes and methodologies used. These will be reported in the discussion section, where both cases will be discussed in the light of the lessons learned from the implementation of the cases. Before doing that the following section will describe the second case briefly.

6.5.2 Development of a Methodology for a Regional Foresight exercise

A Regional Foresight exercise was conducted in the Berlin-Brandenburg region in the context of the EU-funded BEFORE (Benchmarking and Foresight for Regions of Europe) project. One of the objectives of the project was to carry out Foresight studies with the aim of analysing the future challenges on the subject of Research and Technological Development (RTD) of the selected European regions. First regional Foresight activities started in Brandenburg in 2008 on two sectors: Renewable Energies and Logistics. The particular exercise on Renewable Energies aimed at supporting Research and Technology Development (RTD) programs and to set policies for sector. First, actions were taken for the comprehensive 'understanding' of the regional context and the sector. The activities undertaken included:

- Descriptions of the sectors at the regional level
- Analysis of the trends and drivers in Renewable Energies and Logistics sectors
- Review of other Foresight exercises at different levels including global, European, national, regional and sectoral level exercises, which could provide context for the sectoral Foresight exercises
- Preparation of a scoping document for Regional Foresight, which aimed at clarifying the rationales and key objectives of the exercise, regional and sectoral actors and stakeholders, and a list of participants of the exercise

Based on the initial analysis of the region and the sector, a workshop proposal document was prepared, which provided an in depth 'understanding' of the regional and sectoral contexts and the content of the exercise. Following this preparatory work, the first workshop was held in Potsdam, Germany in late September 2007. This inclusive meeting hosted participants from research centres, academia, regional policy makers and representatives of associations. The goals of the meeting were to discuss and develop an understanding of the regional and sectoral contexts. This activity informed the methodology of the Foresight exercise in a greater detail.

In the light of this background work and during the interactive discussions during the workshop, key objectives were agreed for the Foresight exercise. These objectives were classified under three main pillars, which constituted also the outcomes expected from the Foresight exercise:

1. Key technologies (e.g. identify key technologies for the next 10–20 years; promote technology learning; strengthen technology transfer; utilize existing technologies; and involve in the development, shaping and expert technologies)
2. Structural and organizational improvement of the sector (e.g. improve collaboration among actors; improve supplier/value chains; initiate new partnerships and investments; establish state-wide SME network; and establish international activities)

3. Policies and strategies for the Renewable Energies sector (e.g. improve competitiveness of companies, scientific organizations and intermediaries; establish the capital region as relevant and attractive location; improve services; and exploit a large market in the region and beyond)

Following a comprehensive thought experiment to understand the sector, three methodological pathways were suggested in line with the objectives, which then led to the development of the overall methodology: (1) Technology Path; (2) Structural Path; and (3) Policy path

6.5.2.1 Technology Path

The following methods were used to identify critical technologies in line with the objectives given above:

- **Scanning:** For the analysis of STEEPV systems and discuss their implications on technologies
- **Bibliometrics/Literature Review:** For the review the technologies to generate energy and discuss in panels which are relevant and promising for Brandenburg (considering industry's and people's needs, other energy needs – i.e. to produce and to export energy generation devices/instruments)
- **Key Indicators/Forecasts:** Analysis of sectoral forecasts and long term projections on technologies
- **Synthesis:** For the review and synthesis of the previous Foresight work
- **Scenarios** with wide participation (including citizens) identify the 'demands of society' from the technology
- **Delphi:** Represents the 'supply' side – whether the demands in the scenarios are possible and feasible or not. Helps to define time of realisation for selected technologies and technology areas. Also helps to identify priority technologies
- **Roadmaps:** For the development of Technology Roadmaps for prioritised technologies at different levels such as Technology – Product/Capability/Development/Research
- Produce a list of **critical technologies**
- Suggest **R&D projects** and plan R&D activities and resources

The Technology path is illustrated in Fig. 6.6.

6.5.2.2 Structural Path

A combination of the following methods was used to propose actions for structural and organisational transformations:

- **System Analysis:** Analysis of the value chain helps to come to a better understanding of how the sector works and what the actors/stakeholders are

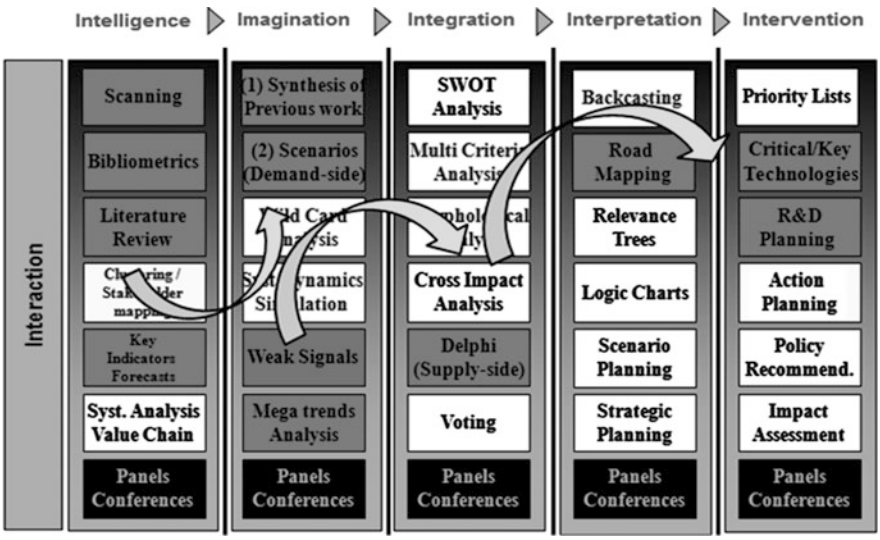

Fig. 6.6 Technology path

- **Clustering** by stakeholder mapping helps to map the actors in the sector and to indicate 'who is doing what'
- **Mega trend analysis:** Sectoral megatrends will give clues on changing roles in the sectors and inclusion of new actors/stakeholders in the process in the future
- **Scenarios:** Various scenarios around Input–output relationships illustrate the future organisation of the sector
- **SWOT analysis** of the existing structures against the structures suggested in the visionary/most desirable scenario
- **Delphi:** To identify types of collaborations needed among stakeholders in order to establish new links in the system
- **Strategic plans:** for the restructuring of the sector in the medium term
- **Action planning:** To suggest immediate actions to change/improve structures and organisations and to introduce new rules and regulations

The Structural path is illustrated in Fig. 6.7.

6.5.2.3 Policy Path

A Policy path was designed for the Renewable Energies sector with the combination of the following methods:

- **Scanning:** For the analysis of Social, Technological, Economic, Ecological, Political and Value (STEEPV) systems to understand what type of energies will be needed and what kind of demand will come out

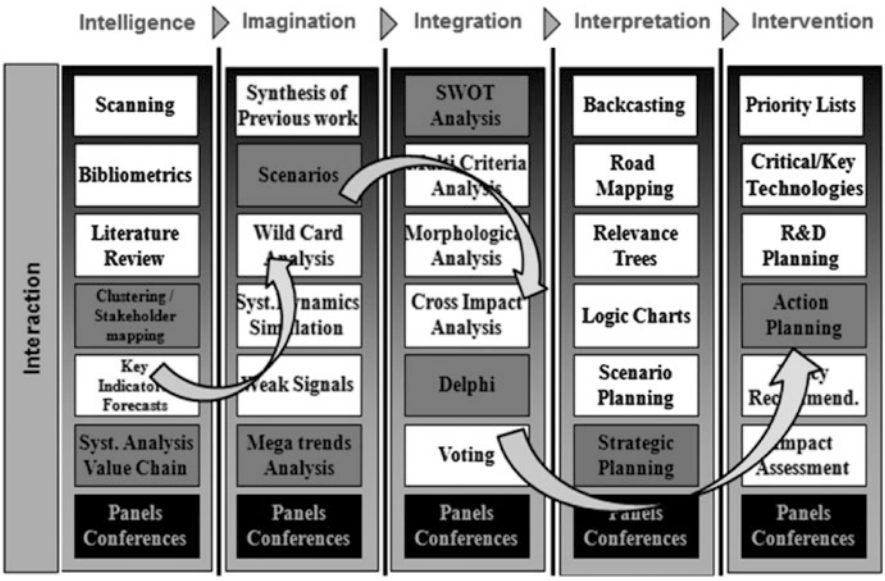

Fig. 6.7 Structural path

- **Key Indicators/Forecasting:** For the analysis of sectoral forecasts and long term projections
- **Mega trend analysis:** To understand the broad policy tendencies at the Global/European/National levels
- **Synthesis of previous work:** Large amount of the work on energy futures exists including plenty of scenario work (reviewing those scenarios would be useful to suggest a set of "synthesis scenarios")
- **Scenarios:** To discover alternative futures on policy developments
- **SWOT analysis** of the regional capabilities against the visionary scenario
- **Roadmapping:** Illustrating the priority areas, the actions to be taken in long, medium and short terms and the distribution of initiatives among the actors in the sector
- **Policy Recommendations:** Policy actions to be taken in the short term

Figure 6.8 illustrates the Policy path to achieve socio-economic and technological transformations.

6.6 Discussion

Both cases presented above aimed to demonstrate two applications of the SFM. The purpose was to explore whether or not there was a practical support for the SFM. Overall, the cases have revealed that:

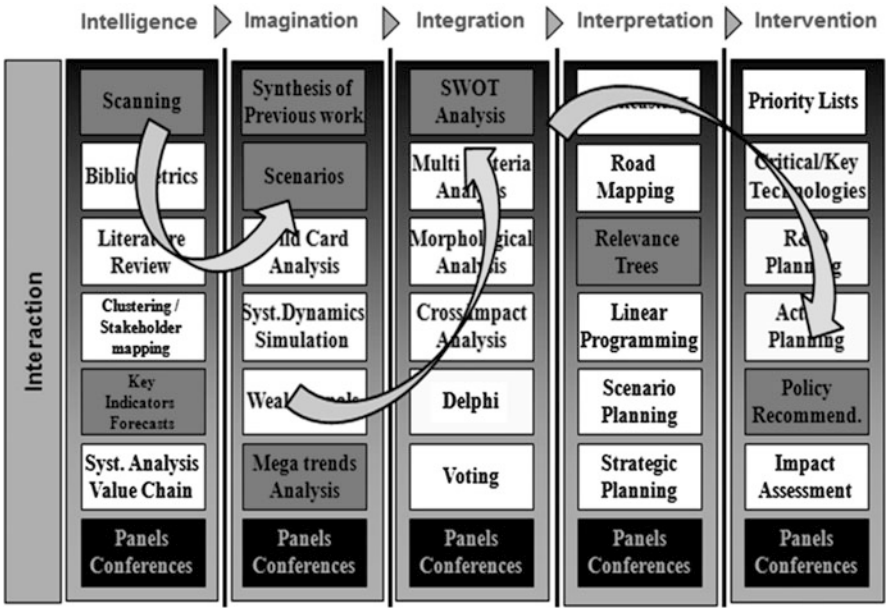

Fig. 6.8 Policy path

1. The ideas created in institutional Foresight exercises can be placed within a systemic framework, once systems with wider boundaries are constructed, are considered in idea creation, and are shared with the participants and wider stakeholders
2. The institutional Foresight system can be integrated into the system in which it operates through the systemic understanding of the external and internal contexts and the construction of the contents in the Systemic Foresight process
3. Institutional Foresight exercises can be carried out without systematic and method-bound approaches. The sum of purposeful and coordinated activities exhibit positive and functionalist characteristics where the pedestrian nature of the institutional Foresight process is mainly overlooked. Due to their soft characteristics, interpretive approaches allow for the design for the minimally bounded exercises and for the development of methodologies, which can reflect the unique context of the activity and nature of the issue at hand.

Now, the following section briefly discusses how these three fundamental propositions of the SFM were illustrated.

The ideas created in institutional Foresight exercises can be placed within a systemic framework, once systems with wider boundaries are constructed, are considered in idea creation, and are shared with the participants and wider stakeholders. In both cases, attempts were made to understand how the systems were constructed as parts of the same upper level system and/or as interacting systems in the scope of the Construction and Renewable Energy sectors.

The holistic view adopted helped to turn attentions to other external systems and how they are constructed. The content of the exercises consisted of a model of the context as a representation of the reality from the perceptions of the two academic units. Models were used from the beginning of the exercises. Thus, the participants had representations of the present and future systems. Through these exercises, the participants came to a better appreciation that the future success and viability of their organizations were also dependent upon the other systems. Seeing their organizations as parts of other larger systems, they were also able to see how their decisions at the organizational level can have impacts on society and other external systems.

The systemic models produced were shared also with the external participants when consultation was needed, for instance via the Construction2023 survey in the case of PYY and BUIM. The use of similar systemic framework made it possible to integrate the information coming through external consultation with the ideas produced in the exercise during the entire process.

Throughout the exercises systems were represented in a relatively diverse forms such as systemic influence diagrams (e.g. systems-actors-factors representations, construction scenario systems, value chain systems, and roadmaps) and matrix forms (e.g. actors-success factors matrix); and in the form of scenarios (e.g. systemic scenario framework, which led to the development of a number of scenarios and finally success scenarios). Consequently, the idea creation was systemic throughout the exercises, and the ideas created were integrated and connected, and thus were not isolated and fragmented.

The PYY2023 and BUIM2023 Systemic Foresight exercises helped the academic units to acknowledge their need and desire for the rectification of their underlying norms, policies and objectives. This was an example of the "*double-loop learning*", where fundamental changes in the organizational behaviours and structures are introduced such as the revealed need for the departmentalization of the division of PYY. The SFM also suggests that this is a continuous process, which is congruent with Vickers's (1965) "*Appreciative System*". The first cycle of the loop was completed with the completion of the exercises, which resulted with a list of actions to be implemented for the change process. This first cycle should be followed by other iterations of the SFM to achieve continuous improvement.

Both cases also attempted to provide continuity and consistency with the other future oriented efforts at the regional, national and European levels. For this purpose, the outcomes of the Foresight exercises at these levels were made available to the participants during the process. The idea was that the outcomes of the other regional, national and European Foresight exercise would guide decisions taken at the sectoral level and thus could prevent 'punctuation'.

The institutional Foresight system can be integrated into the system in which it operates through the systemic understanding of the external and internal contexts and the construction of the contents in the Systemic Foresight process. Both Construction and Renewable Energy sectors were embedded in various systems including the global, national, industrial and academic systems. These systems constituted the external contexts for the institutions where the

exercises were conducted. The internal organizations, cultures, values and behaviours constituted the internal contexts. From the beginning of the Systemic Foresight exercises, these contexts were considered and incorporated. Due to the differences in the contexts, the exercises were approached from an interpretive perspective, where the host organizations were considered as social and living systems.

When the exercises started, the phases of the SFM were introduced to provide a methodological framework to ensure that the academic units achieve the objectives and complete the exercises successfully. The processes then evolved and differentiated through the interplays with contexts and contents. For instance, different practices emerged in the exercises due to the internal contexts of PYY and BUIM. The analyses revealed the strong impacts of structural and behavioural factors. In addition, the nature of the different subjects at hand, including PYY's construction and management and BUIM's civil engineering affected the processes.

Systemic representations used, such as the relationships between systems through their impacts on each other, helped to visualise that PYY and BUIM were affected by and could affect not only the developments in the construction sector. Before this activity, it was considered that the construction industry is one of the most vulnerable the economy and this vulnerability had negative impacts on PYY and BUIM. However, this activity helped the members of PYY and BUIM to understand that their success could also correspond to the developments in the world, other international and national academic systems and in the global construction industry. Consequently, both the sector and academic departments were not as vulnerable as they considered themselves against the negative developments in the national economy and the construction sector.

It is important to emphasize that the impacts of the content on the process was more predictable compared to the impacts of the behavioural factors, which revealed only through the process of the exercise.

Institutional Foresight exercises can be carried out without systematic and method-bound approaches. The sum of purposeful and coordinated activities exhibit positive and functionalist characteristics where the pedestrian nature of the institutional Foresight process is mainly overlooked. Due to their soft characteristics, interpretive approaches allow for the design for the minimally bounded exercises and for the development of methodologies, which can reflect the unique context of the activity and nature of the issue at hand. Based on the assumptions of the SFM, where Foresight is considered as a social and living process of inquiry, the Systemic Foresight exercises described started with the (i) Specification of systems, (ii) Identification of external and internal contexts, (iii) Characterization of the nature of the subject at hand, which then constituted the content of the exercise, (iv) Clarification of the goals. In this respect, an interpretive approach was developed which could deal with the unique structural and behavioural characteristics of organizations.

The formal methods used in the exercises came onto the agenda once the exercises started to follow the specification of the external and internal contexts and the contents. Based on the consideration that well-established, procedural and

Table 6.1 Methods used in the Renewable Energy Foresight exercise[a]

Phases	Methods	Technology path	Structural path	Policy path
Intelligence	Scanning	⋆		⋆
	Bibliometrics	⋆		
	Literature review	⋆		
	Key indicators	⋆		⋆
	Stakeholder mapping		⋆	
	System analysis		⋆	
Imagination	Megatrend analysis	⋆	⋆	⋆
	Scenarios	⋆	⋆	⋆
	Weak signals	⋆		
Integration	SWOT analysis		⋆	⋆
	Delphi survey	⋆	⋆	
Interpretation	Roadmapping	⋆		
	Relevance trees			⋆
	Strategic planning		⋆	
Intervention	Critical/Key Tech.s	⋆		
	R&D planning	⋆		
	Policy recommendations			⋆
	Action planning		⋆	

[a]As mentioned earlier the Renewable Energy project has not been evaluated, therefore the table does not involve the impact phase

prescriptive rules would not be suitable for social and human systems, no predetermined method was imposed. Consequently, the exercises started with the basic phases of the SFM. Methods came onto the agenda once an understanding of the situation was developed and possible solutions were negotiated. Specific methods were used whenever they were needed. New uses for common methods were also developed, such as the 'systemic scenario development', which used interaction diagrams to develop a number of different scenarios for the future. Table 6.1 shows how quantitative and qualitative methods were selected and used in the Renewable Energy Foresight exercise in Berlin-Brandenburg based on the phases of the SFM. The table demonstrates the methods, which served for policy, technology and structural paths. It is notable that some methods such as scenario planning can serve for all three purposes.

Both exercises created ideas in systemic frameworks, which prevented fragmentation and punctuation. Focus was given to higher and lower level of systems. The hierarchy and interrelationships between these systems and their elements were considered throughout the exercises.

6.7 Conclusions

Institutional Foresight is a combination of technical and thought processes. Technical process is largely a matter of organising and managing a Foresight exercise as a 'systematic' activity. The SFM suggests that Foresight also involves a set of 'systemic' processes, which are about how systems (e.g. human and social systems, industrial/sectoral systems, and innovation systems) are understood, approached and intervened for a successful change programme. The success of a Foresight activity will largely depend on how well the technical and thought processes fit and follow each other. The phases and strands of the SFM provides a conceptual systemic framework to provide methodological guidance for the organizers and practitioners of Foresight. Designing a Systemic Foresight exercise geared to a specific field and its specific nature has three advantages as it:

1. Provides a greater flexibility in dealing with specific issues
2. Leads to the development of diverse and more appropriate approaches in Foresight
3. Makes implementation easier as the products (i.e. policies and strategies) would be more compatible with the nature of the subject at hand

Briefly, the Systemic Foresight claims that:

1. The process of policy creation (means) and policy content (ends) are entirely complementary
2. The content is a determinant factor for the process
3. The process itself is a conditioning factor on what might emerge as content

The SFM suggests an iterative, dynamic and non-linear process for Foresight. Thus, attentions are turned from individual elements/issues to systems. Attempts are made to see and understand how systems are constructed and integrated. Then, models are generated on the future systems and interconnected policies and strategies are suggested. During this process, the SFM considers the uniqueness of systems, which is due to their structures and behaviours. Therefore, the SFM considers the 'soft' characteristics of systems while creating information for society under uncertainty and complexity.

The discussion on methods comes after clarifying the systems and their boundaries. The SFM suggests that the contexts in which Foresight lies have continuously evolving characteristics and are dominated by subjective views. Therefore, each situation requires a specific methodological approach. Last but not least, the SFM aims to provide a conceptual framework to meet expectations for inclusivity, transparency and interaction. Fully fledged applications of the SFM are currently in progress. Among those Energy and Security Foresight exercises for the University of Manchester; National Research Foresight Programme for Mauritius; and Foresight for International Natural Fibers Organization (INFO) can be given as examples.

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