SYSTEMIC FORESIGHT METHODOLOGY

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Abstract

The paper introduces the Systemic Foresight Methodology (SFM). Based on the ideas of systems thinking, the SFM aims at proposing a conceptual framework, which recognises the complexities involved both in real world systems and in idea creation, which emerge due to multifaceted interplays between the Social, Technological, Economic, Ecological, Political and Value (STEEPV) systems. Conducting Foresight systemically involves a set of ‘systemic’ thought experiments, which is about how systems (e.g. human and social systems, industrial/sectoral systems, and innovation systems) are understood, modelled and intervened for a successful change programme. The thought experiments are conducted in an iterative, dynamic and evolutionary process for Foresight which involves the phases of (1) Systemic understanding (understanding and appreciating situations) (2) Systems synthesis and modelling (synthesising input into models), (3) Systemic analysis and selection (analysing alternative futures and prioritising them), (4) Systemic transformation (establishing the links between the desired future and the present), and (5) Systemic action (informing present day decisions). The SFM described in the paper aims to provide theoretical and conceptual frameworks to support Foresight organizers and practitioners to cope better with the complexities of the human and social systems. The ideas presented are discussed with two Systemic Foresight cases on Higher Education and Renewable Energy sectors. The cases demonstrate the full implementation of the SFM and how the SFM was used to combine quantitative and qualitative methods to build a methodology in line with the contexts and contents of the Foresight exercises.

Keywords: Systems Thinking, Systemic Foresight, Complexity, Uncertainty, Foresight Methods

1. Introduction

As an unavoidable human trait of thinking about the future, foresight has been there 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, Future-oriented Technology Analysis (FTA). More recently FTA 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 FTA 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.
Although, it is observed that the nature of the situations has changed and has become more complex and uncertain, the way FTA deals with them has remained largely unchanged. ‘Systematic’ processes were designed with pre-determined methods to tackle ‘systemic’ situations involved in human and social systems, which are ‘open’ in nature and require customised methodological approaches. Consequently, a need has occurred to improve the FTA practice to tackle these new situations, which require creativity and diversity in the use of FTA methods. Any new FTA approach in this regard should aim for understanding these complex systems and their behaviours, and thus needs to be ‘systemic’ and context dependent.

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 FTA methodology with the integration of qualitative and quantitative FTA tools in line the nature of situations. The SFM sets out to create systemic concepts 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 ‘mental acts’ of (i) Systemic understanding, (ii) Systems synthesis and modelling, (iii) Systemic analysis and selection, (iv) Systemic transformation, and (v) Systemic action.

Each of these steps aims 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 mental acts 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.

Conducting Foresight systemically involves a set of thought experiments, which is about how systems are understood, modelled and intervened for a successful change programme. Therefore, SFM does not attempt to impose any methods from the earlier phases of the systemic inquiry. Rather, a set of thought experiments are suggested to provide an epistemological framework for the construction of an evolutionary Foresight methodology, which involves:
1. **Information** to understand complex interactions between products, services, users and other stakeholders in multiple contexts in which these products and services are used

2. **Intelligence** through scanning to explore novel ideas, unexpected issues and shocks, as well as persistent problems or trends

3. **Imagination** in a holistic innovation ecosystem by integrating Foresight, Creativity and Design for scientifically possible, technologically feasible and socially desirable futures

4. **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,

and finally with an effective **Implementation** for a successful transformation programme.

The SFM described in this paper provides theoretical and conceptual frameworks for the design of a methodology with the selection and integration appropriate mixture of FTA methods. The approach will be demonstrated with a case study on the future of Renewable Energies.

Thus, the next section provides a brief overview of institutional Foresight as a systematic activity and the evolution of practice in time. Then the third section focuses on the underlying concepts of systems thinking, which will constitute the basis for the development of a Systemic Foresight Methodology (SFM). The fourth section describes the SFM and its phases. Section five describes how the methodology for a regional Foresight exercise was developed by using the SFM. The results of the case studies are discussed in section six. The paper is rounded off with the conclusion that the SFM might be a useful conceptual framework when designing a Foresight exercise involving complex social and human systems.

### 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 16th to 18th 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 19th 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-20th century. First computer simulation studies were becoming well known around the same time.

During the 1950s and 60s, 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.

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’s next? Foresight shapes the world through policy, but it is also shaped by the wider contexts and developments in this 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 suggests 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 Systemic Foresight Methodology (SFM).

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 and 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; and 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 behaviour of the other(s). It is embodied through communication among system elements via ‘feed-back’ and ‘feed-forward’ channels (Kay et al., 1999; and 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. Overall system behaviour depends critically on how well the elements fit and work
together, not merely how well each performs individually. Thus the consideration of causality in systems turns attentions from individual system elements to systems. This point 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.

*The whole is more than the sum of its parts.* This consideration is based on the idea that complex wholes are inherently greater than the sum of their parts. In this manner, holism does not seek to break down complex situations into their parts when studying them, because the properties of a system cannot be ascribed directly to their component parts, but arise due to the interactions among them. Such properties are called “emergent properties” (Smuts, 1926; Phillips, 1977; and Gilbert and Sarkar, 2000).

*The parts cannot be considered in isolation from the whole.* Properties of each part are dependent upon the other parts of the system. The real world and the process of inquiry are both systemic in the sense that they are interconnected ‘wholes’ and exhibit emerging properties. Exploring or generating systemic relationships in this interconnected whole requires holistic understanding. Like in the real world, in the process of inquiry ideas cannot be created by considering them in isolation from the rest of the system that they are part of (Forrester, 1961; Richardson, 1991; and Jackson, 2001).

*The behaviour of the system cannot be understood independent from its context.* A system is situated within an environment which constitutes its context. A system cannot exist without its context. The overall system behaviour is not independent from its context. Consequently, from the systems thinking viewpoint, not only the system itself, but its context becomes worthy of consideration (Pettigrew, 1985 and 1987; and Walsham, 1992).

**Hierarchy.** In systems terms 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; and 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. Simon (1962) and Rasmussen (1985) claim that most of the complex systems are formed through some hierarchical evolution. However, in such complex systems, the definition of boundaries of an existing or a future system will be based on observer’s perception. Considering that the boundary definition is abstract and philosophical, especially in human and social systems, and is defined with the ‘bounded rationality’ of the observer, it can be concluded that the identification of hierarchy can be problematic itself.

**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. In the single loop learning, given or chosen goals, values, plans and rules are operationalised rather than questioned. The change is in the action, not in the
governing variable itself. When an action is taken by an individual or an organisation, usually routines and present plans are followed. Therefore, it can be said that the system is closed on itself. The double-loop occurs when continuity involves the modification of an organisation's underlying norms, policies and objectives. In this case, both the governing variable and the action strategy change. Hence, the double-loop learning represents a more dynamic and open system. As a consequence, system reproduces a continually changed self (Argyris, 1976; and Argyris and Schon, 1978). The recursion of the looped action sequence in time brings the second type of continuity. Vicker's “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 the 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; ‘soft’ or ‘interpretive’ systems approach; and a more recent addition ‘emancipatory’ or ‘radical’ systems approach. These approaches have all been built upon the basic features of systems thinking, which were described earlier. 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 available resources (Simon 1957 and 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 will determine the kind of system approach to be used for understanding and intervention.

4. Systemic Foresight Methodology (SFM)

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 (Figure 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:

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. Table 1 exemplifies some of the elements of the STEEPV systems.

**Figure 1: Systemic Foresight concept**

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**THEME 3: COMBINING QUANTITATIVE AND QUALITATIVE TOOLS**
Table 1: Elements of the STEEPV systems

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social</td>
<td>Ways of life (e.g. use of leisure time, family living patterns), demographic structures, social inclusion and cohesion issues (fragmentation of lifestyles, levels of (in)equality, educational trends)</td>
</tr>
<tr>
<td>Technological</td>
<td>Rates of technological progress, pace of diffusion of innovations, problems and risks associated with technology (including security and health problems)</td>
</tr>
<tr>
<td>Economic</td>
<td>Levels and distribution of economic growth, industrial structures, competition and competitiveness, markets and financial issues</td>
</tr>
<tr>
<td>Environmental</td>
<td>Pressures connected with sustainability and climate change, more localised environmental issues (including pollution, resource depletion, and associated biodiversity, and welfare concerns)</td>
</tr>
<tr>
<td>Political</td>
<td>Dominant political viewpoints or parties, political (in)stability, regulatory roles and actions of governments, political action and lobbying by non-state actors (e.g. pressure groups, paramilitaries)</td>
</tr>
<tr>
<td>Values</td>
<td>Attitudes to working life e.g. entrepreneurialism, career aspirations, deference to authority, demands for mobility (across jobs or places), preferences for leisure, culture and social relations</td>
</tr>
</tbody>
</table>

All these systems and their elements are interrelated and interdependent and these complex relationships constitute the real world situations. Loveridge and Saritas (2009) have formulated three questions to be asked as a starting point to investigate into those relationships (Figure 2).

Figure 2: Questions for Systemic Foresight
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, equipments and technologies) and behaviours (e.g. culture, politics, social 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.

A rich understanding of the context and content of change is a first and foremost requirement to design the process of Foresight, which can be defined as: “the actions, reactions, and interactions from the various interested parties as they seek to move the [organisation] from its present position to its future state” (Pettigrew, 1987, p.658). The SFM suggests a Foresight practise where attempts are made first to understand the context of the exercise, to take it into account to construct the content of the activity, and then to design a systemic process of inquiry for understanding and action.

**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 mindset 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).

According to Loveridge and Street (2005), inclusive Foresight needs to be:

- Investigative – it needs to be based on questioning of received wisdom
- Integrative, acknowledging that inclusive Foresight is:
  - Characterised by systems with interactions involving feedback, feed-forward and other aspects of systems behaviour
  - Likely to exhibit complexity
  - Likely to exhibit aspects of trans-science
  - Influenced by the dynamic balance between the forces of modernity and post-modernity
- Independent to enable: freedom of thought; freedom of access to people and information sources; and freedom of reporting
- Participatory enabling whoever wishes to take part to do so through process that are: easily accessed; easy to use; and credible to programme sponsors and their audience
- Systemic in order to understand how systems work and behave. This will inform the profiles of stakeholders / experts / lay people to be involved in a Foresight exercise, and will portray their relationships

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.

Some useful approaches may be found to deal with the behavioural matters in Foresight such as Ulrich's (1977, 1983, and 1987) Critical Systems Heuristics (CSH). CSH recognises that various stakeholders in society may see ‘situations’ in radically different ways because different stakeholder values and behavioural characteristics lead to different boundary judgements. In this way, the complexities imposed in socio-cultural systems where, for example, conflicts and unequal power distribution occur, maybe taken into account. This ‘radical’ view accepts that stakeholders may be in unequal in terms of their power, states and other behavioural characteristics such as ‘trust’. The role of the behavioural matters in Foresight and how these were made explicit during a Systemic Foresight process will be demonstrated with the cases presented in the later sections of the present paper.
4.2 The thought processes involved in 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 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 (Keating et al., 2001).

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 ‘mental acts’ of:

1. Systemic understanding
2. Systems synthesis and modelling
3. Systemic analysis and selection
4. Systemic transformation
5. Systemic action

The mental acts 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 mental acts 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 Systemic Foresight approach. Methods 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. The methods are selected and integrated following a comprehensive ‘understanding’ exercise. In this way, methodological solutions are produced after a diagnosis of the situations. Figure 3 illustrates the five phases of the SFM.
**Systemic understanding**

Understanding is the first and fundamental step of the Systemic Foresight process. The systems Foresight deals with are usually complex systems. Roe (1998) views complexity “as anything we do not understand, because there are apparently a large number of interacting elements.” According to Roe, the appropriate approach to complexity is to embrace it and resulting uncertainty and to analyse different subsets of interactions 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) 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, understanding starts from the beginning of the Foresight process and provides input for the overall activity. Understanding seeks to attain a reasonably comprehensive view of situations. 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 mindset for understanding how systems work and behave. The aim is not necessarily to bring about a convergence of views, however, at least a partial convergence is likely to emerge from this process in practice.

When a system is approached, two kinds of understanding can be mentioned:

1. Understanding the system ‘spatially’
2. Understanding the system ‘dynamically’ and ‘historically’

With regards to space, attention is paid to the nature of the system under study and its structure (i.e. organisational and functional structure). Understanding the system dynamically and historically refers to seeing the system as an evolutionary entity by considering its behaviour in time. The SFM places a great emphasis on scanning and modelling in order to understand systems and their behaviours. When situations are examined, first systems are searched for and analysed; and then information on those systems such as history, formal and informal structures, and stakeholder perspectives are collected by reviewing and scanning. Looking at the interrelationships and interdependencies between systems and their elements, the boundaries of the systems are negotiated, which is a matter of philosophical and epistemological importance. Models are produced as an outcome of the boundary setting process. These models can initially be linguistic and figurative; therefore this process should not be seen as an immediate engagement with mathematical or empirical forms of modelling.

The initial models ought to promote understanding of systems and situations within the limits of uncertainties, which is involved in surrounding formal knowledge and information flows. The models produced are open to revision if interpretation does not support the premises of modelling, bearing in mind that the model is not reality. Quality checks on interpretation, though subjective, depend on the notions of relevance and reasonableness, and to lesser extent on robustness. Some modelling work might benefit also from quantitative modelling techniques at the later stages of inquiry.

Modelling, which should not be confused with methods, is at the core of Foresight by formalising thought experiments and, through feedback, and their extension. Modelling leads to the further development of Foresight process and similarly the presentation of the outcome.

Understanding, appreciation and then visualisation of systems allow for:

1. A holistic view where the attention is turned not only the systems under investigation, but also on the other external systems, and interrelationships and interdependencies between them
2. A step towards understanding the context, within which the organisation looks for ongoing cycles, trends or emerging issues of change, such as innovations, value shifts and deviations.
3. A step towards developing ideas on how to intervene into systems in order to create a lasting change.

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 factors or ‘weak signals’ of change, which would have strong potentials to change the existing system into a more desirable future system.

Thus, understanding helps to set out the rationales and objectives of the exercise and to scope the exercise by defining its boundaries. Following the appreciation of systems and diagnosis of issues, understanding provides a background for the design of the methodology and assists the identification of stakeholders and actors in the system. Decisions can be taken on the shape and size of the activity after this phase.

The understanding phase is iterative and is repeated in different forms for different purposes throughout the Foresight activity. Besides scoping the exercise, understanding is also the first step of idea generation to appreciate how the specific sector or thematic area is organised and positioned in the overall STEEPV systems. This will help to recognise the interrelationships and interdependencies between those systems and will encourage ‘out-of-the-box’ thinking from a wider lens. This phase is mainly carried out with a ‘holistic scanning’ of the STEEPV systems. Scanning provides the basic input to the entire activity. Selecting the main areas for intervention, the boundaries of the Foresight are drawn and the ‘content’ of Foresight is built. Various other Foresight techniques can be used to create input for the understanding process including bibliometrics, literature review, and analysis of trends, drivers, weak signals, wild cards, discontinuities and key indicators.

**Systems synthesis and modelling**

The input gained from the understanding and scanning exercise is synthesised 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 some form of agreeable and workable models. The models produced at this phase 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. The output of this phase are the ‘models of the future’, which do not necessarily pretend to be complete and quantifiable. 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.

Systemic analysis and selection

Following the construction of alternative models of the future, this 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.

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.

Systemic transformation

Following the decision on the most desirable/preferable future, this phase aims to connect this future with the present and suggests actions to be taken. Thus, transformation 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 (v) 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:

THEME 3: COMBINING QUANTITATIVE AND QUALITATIVE TOOLS
1. Assessment (e.g. processing information; developing an understanding of the continuously changing context; and becoming an open learning system)
2. Leadership (e.g. having a context-sensitive leadership; creating capabilities for change; linking actions with resources; and constructing a climate for change)
3. Linking strategic and operational change (e.g. supplying visions, values and directions; implementing intentions over time; and implementing supportive activities)
4. 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)
5. 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.

Systemic action

Any Foresight exercise has to inform policies and actions. This is the final phase, which is concerned with the creation of plans 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:

1. Adapting
2. Influencing and shaping its context
3. Finding a new milieu or modelling itself virtuously in its context
4. 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.

All mental acts 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 in a similar stance with Argyris and Schon’s double-loop learning and Vicker’s Appreciative System, which were described briefly earlier. 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.

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 not only be a methodologically ‘systematic’ activity, by creating its own methodological approaches with the consideration of the nature of the issue at hand and its context. Situations and models will drive the methodology in systems thinking. 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 ‘thought process’, which starts with the ‘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.

Instead of imposing any particular method, the SFM benefits from a pool of available foresight and forecasting methods and other planning and policy tools. However, it is considered to be useful, particularly for the practitioners, to specify various methods, which might be of use for each phase of the Foresight process (Figure 4).

**Figure 4: Classification of Foresight methods**

Each column in the figure indicates a phase of the systemic foresight process. The selection and integration of methods in the list are done under the guidance of the mental acts with a close

**THEME 3: COMBINING QUANTITATIVE AND QUALITATIVE TOOLS**
interaction with the context, where the Foresight activity takes place and is expected to improve. All methods involve a certain degree of information input, creativity, expertise and participation. 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.

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 develop visions. The second case briefly demonstrates how the 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. The first case demonstrates the full implementation of the SFM and emphasises the ‘soft’ nature of Foresight, whereas the second case describes how the SFM was used to combine quantitative and qualitative methods in line with the context and content of the Foresight exercise.

5.1 Systemic Foresight in Universities

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.

The Process

A project process consisting of the five phases of the SFM was designed. Being the integral parts of the projects, the phases gave direction 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 (Systemic Understanding)
3. Construction20231 (Systems Synthesis and Modeling)
4. PYY/BUIM2023 (Systems Modeling, Analysis and Selection)

1 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.
5. Road mapping (System Transformation)
6. Decisions for today (Systemic Action)

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

**Understanding systems, elements and relationships**

Understanding and appreciation of the systems were seen as imperative. Systemic understanding 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, the second phase:

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 analyzing the relationships between them

**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
3. Relevant education and training (E&T) areas

**THEME 3: COMBINING QUANTITATIVE AND QUALITATIVE TOOLS**
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.

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.

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.

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

### 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
3. Policy path
Technology Path

The following methods were used to identify critical technologies:

- **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 Figure 5.

![Figure 5: Technology Path](image)
Structural Path

The combination of the following methods were used to propose actions for structural and organizational 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
- **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 Figure 5.

![Figure 6: Structural Path](image)
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
- **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 7 illustrates the Policy path to achieve socio-economic and technological transformations.
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:

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 pictures 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 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 behaviors 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 “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 behaviors 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 behavioral 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 behavioral 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 prescriptive rules would not be suitable for social and human systems, no predetermined method was imposed. Consequently, the exercises started with the basic mental acts 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 2 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.
### Table 2: Methods used in the Renewable Energy Foresight exercise

<table>
<thead>
<tr>
<th>METHODS</th>
<th>Policy Path</th>
<th>Tech Path</th>
<th>Structural Path</th>
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<tbody>
<tr>
<td>Scanning</td>
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<td>Bibliometrics</td>
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<tr>
<td>Literature Review</td>
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<tr>
<td>Key Indicators</td>
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<td>Stakeholder Mapping</td>
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<td>System Analysis</td>
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<td>Megatrend Analysis</td>
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<tr>
<td>Scenarios</td>
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<td>Weak Signals</td>
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<td>SWOT Analysis</td>
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<td>Delphi Survey</td>
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<td>Roadmapping</td>
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<td>Relevance Trees</td>
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<tr>
<td>Strategic Planning</td>
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<tr>
<td>Critical / Key Techs</td>
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<td>R&amp;D Planning</td>
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<td>Policy Recommendations</td>
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<tr>
<td>Action Planning</td>
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</tbody>
</table>

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.

### 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 ‘systemic’ thought process, which is 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 SFM provides a conceptual systemic framework to provide 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. The SFM aims to provide a conceptual framework to meet expectations for inclusivity, transparency and inclusivity.

References


