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Systemic analysis of UK foresight results Joint application of integrated management model and roadmapping

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Abstract

This paper proposes a new systems approach to foresight studies. The paper will first indicate the complex and conflicting nature of long-term decision-making process. Then, the need for systems approach will be highlighted by the analysis of 1995 UK Delphi survey results and the scenarios of 2000 UK foresight scenarios. The paper proposes two methodologies, namely Integrated Management Model (IMM) and Roadmapping, in order to overcome challenges introduced by the multidimensional characteristics and complex nature of foresight studies. Based on systemic approach, IMM offers a useful way of developing long-term normative policies and strategies and their transformations into actions by considering necessary changes in organizational structures and behaviors. In addition, roadmapping is used to capture, manipulate and manage information to decrease complexity in the foresight by constructing roadmaps. In the paper, IMM and roadmapping are employed first to analyze UK foresight results and then to develop a new methodology to formulate Delphi events and scenarios for the successful implementation of foresight. This paper also

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promotes the integrated use of foresight techniques such as scenarios and Delphi rather than one for another.

Keywords: Integrated management model; Roadmapping; Foresight

1. Introduction

Because the world is changing in global and local ways, there are many possible futures. This is the reason why the ability to foresee is more important for both national and regional governments, industries and corporations to shape and move towards desired futures for sustainable development. In order to create wealth and increase quality of life, there is an increasing need to be innovative and to manage change and uncertainty.

In 1990s, foresight became very common practice among many developed and developing countries, regions and organizations in every scale, mostly in order to anticipate new technology areas. Although foresight exercises have been practiced broadly, their successful implementations have not been that wide. This is because the implementation is the most challenging stage of a foresight study. Loveridge [1] mentions the challenges in implementing foresight results. The reasons behind these challenges might be attributed to the multidimensional characteristics and complex nature of foresight.

Foresight studies are complex and uncertain, because they try to anticipate the uncertain future with number of affecting factors such as social, technological, economic, ecological and political (STEEP) aspects. Foresight studies are also conflicting as a consequence of participation of different stakeholders in different disciplines with various visions, goals and expectations.

In this paper, we propose that foresight should be about understanding the future of man and his environment as a part of interacting and interconnected system. As Checkland [2] stated, "we, all of us, should be aware of ourselves as beings in the world, and we are also of a very complex world outside ourselves, of which we are part."

In order to discuss the challenges to implementation of foresight studies, the paper firstly presents the uncertain, complex and conflicting characteristics of long-term decision-making in general and foresight in particular. After the brief description of UK foresight programs, the paper summarizes the challenges in implementing foresight outcomes. In the light of this background, we present and reanalyze the results of 1994–1995 UK Delphi and 1999–2000 UK scenarios with a new systemic perspective.

The UK is among the countries that conducted several foresight studies in recent years with various aims such as developing visions of the future, building bridges between industrialists, science and government and creation of wealth and improvement of quality of life [1,3]. The following years indicated that the outcomes of these foresight exercises could not be employed extensively, as it was desired at the beginning (see Refs. [1,4]). This paper raises some considerations and problematic points, confronting the successful implementation of foresight outcomes from systems perspective.

In the final part of the paper, we propose a systems approach to the Delphi and scenario planning[2] by considering all events and statements in foresight as parts of an interconnected whole. As a foresight technique, the Delphi has reductionist inductive-consensual characteristic because it focuses on just particular events separately and reduces all issues to numbers to produce a "single best" or optimal solution to a particular problem [5]. According to Mitroff and Linstone [5], Delphi is appropriate for a very limited class of problems, i.e., bounded, well structured for which single numbers can serve as answers. However, future problems are unbounded, complex and ill structured. As a defender of expansionist perspective, the systems approach has been developed to overcome the problems occurred by reductionist point of view. We suggest systems approach to Delphi and scenario planning in order to enhance their capabilities for future studies. Showing the future picture of society as a whole, scenarios should also benefit from this "big picture" approach.

The systemic perspective proposed in this study should be adopted from the very beginning of foresight for the successful implementation of its outcomes at the very end of the exercise. The paper prescribes that scenarios should be developed in a complementary stance with Delphi in order to convert numerical data into explanatory text to be shared and understood by broader stakeholders.

In this new systemic approach, we employ two models to be used throughout entire foresight exercise for the design and formulation of Delphi events and scenarios. Based on systems approach, Integrated Management Model (IMM) is used to present an architecture for structuring multidimensional management issues from goals, structures and behaviors perspectives. Roadmapping is the second methodology used in complementary stance with IMM to capture, visualize, manipulate and manage information to decrease complexity in foresight by constructing roadmaps. As a tool, defining paths to meet future requirements, roadmaps can assist to connect future's requirements and today's research areas.

2. Nature of long-term decision-making

Because the future does not consist of one path, today we face high level of "uncertainty" and "discontinuity" (see Ref. [6] for three uncertainties and discontinuities we face today). The accelerating rate of change throughout the world intensifies the degree of uncertainty, so as complexity. The rapid and unprecedented change in social, economic and technological issues creates increasingly dynamic, borderless environment that will be very different in the coming decades from that experienced today.

In this dynamic and uncertain environment where the economic, social, technologic, political and environmental systems and their subsystems are far too complex, traditional decision-making instruments have already denoted their shortage as guides in decision-making. The linear thinking had brought great success in 1900s U.S. industrial life with Frederick Taylor's successful applications of predictions in management world. However,

[2] Delphi is a technique widely practiced in foresight exercises. However, the systems approach suggested in this paper is valid for all futures and foresight methodologies and techniques.

as a consequence of the complex structure occurred, the classical reductionist solutions were inadequate when applied to problems and needs that no longer existed in their original form.

Problems of late 20th and early 21st centuries require to be examined from multiple perspectives, because there are "unparallel changes," to use Mitroff and Linstone's [5] term. One of the prime features of today's complex problems is that they quickly involve or turn into a whole system problem [7]. This is the reason why the problems and decisions confronting modern organizations are so complex, profound and interdependent.

The growth of systems complexity brings two disturbing inevitable features in this process [5]:

1. the increase in the possible kinds of catastrophic accidents ("normal accidents," to use Perrow's term) and
2. the demands of management (and decision-making) capability.

Perrow [8] defines "normal accident" as "a signal that, given the system characteristics, multiple and unexpected interactions of failures are inevitable (which is why they are normal). The cause of the accident is to be found in the complexity of the system (p. 7). However, with (enhanced management and decision-making capabilities and) experience, better designs, equipment and procedures appeared, and unsuspected interactions were avoided and complexity and tight coupling were reduced" (p. 5). Hence, it is vital to understand the nature of systems and their complexity.

Ulrich and Probst [9] classify systems and problem situations as simple, complicated, complex and very complex (Fig. 1).

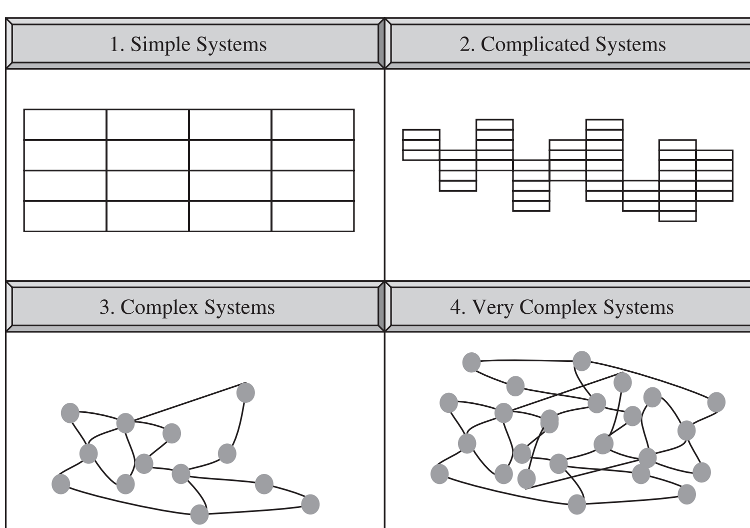

Fig. 1. Nature of systems (figure redrawn from Ref. [9], p. 44).

The number of components of a problem and the dynamic relationship between them determine the solution strategies of problems. Graf [10] draws attention to the fact that any decision-making capability is related to the level of difficulty and degree of extension into the future of the problem situation. The longer the time horizon, the more difficult to understand the complex and dynamic nature of the decision is.

Some decisions in our daily life are so simple that we are not even aware of making and taking decision. We notice that the structure and change rules are constant in these situations. However, as the time horizon lengthens, the impact of known structures on decisions decreases and uncertainty increases (Fig. 2). Under these circumstances, the number of problem components is high, and we are not aware of the type and characteristics of the relationships between these components.

As a long-term decision-making tool, foresight heavily faces the complexity and uncertainty because of its characteristics. Prior to analyzing challenges in implementing foresight studies, we will first summarize general characteristics of foresight studies to indicate their complex, uncertain and conflicting nature. We can sum up these characteristics as follows (see Ref. [11]):

1. *Normative:* In future studies, normativity indicates the relation with specific values, desires, wishes or needs of the future, which will give overall direction for the future.
2. *Participative and transdisciplinary:* Today, most of the problems cannot be analyzed by a single discipline. All complex problems—especially social ones—involve a multiplicity of actors, various scientific/technical disciplines, various organizations and diverse individuals. In principle, each sees a problem differently and thus generates a distinct perspective on it.
3. *Dynamic and complex:* By their very nature, foresight studies are complex. What is important to see is that the more complex the problem is, the greater is the level of uncertainty (see Ref. [8]). Ill-defined and nonstructured problems require higher dynamic complexity.

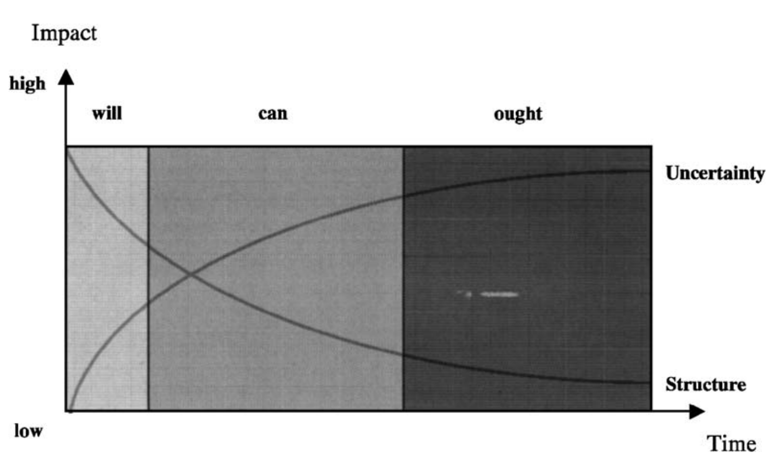

Fig. 2. Structure and uncertainty relationship (figure redrawn from Ref. [10], p. 47).

4. *Uncertain:* Foresight studies to anticipate the uncertain future with a number of affecting factors such as STEEP and their complex structural and behavioral relationships.
5. *Conflicting:* As a consequence of participation of different stakeholders in different disciplines with various visions, goals and expectations, foresight studies are conflicting. There are different interests and ideology among key actors, politicians and public opinion.

In Section 3, we will describe UK foresight programs briefly by considering the characteristics of foresight that we ordered above. We will illustrate the level of complexity, uncertainty and conflict in two previous foresight exercises in accordance with the long-range normative thinking and participation in foresight. Then, we will discuss and highlight the challenges in implementing foresight in the light of our UK foresight study assessments.

3. Brief description and assessment of UK foresight programs

The 1995 UK Foresight Program was set by the Office of Science and Technology (OST), which sponsored the Policy Research in Engineering, Science and Technology (PREST) participation in the foresight program in 1994. The specific objective of the 1995 UK Foresight Program was "to bring together business people, engineers, scientists and government in networks that identify emerging and longer-term opportunities in markets and technologies" [12].

In the foresight study, government departments and steering group defined 15 sectors. Each sector represented in related panel consisting of 20 expert members. The members covered the span of interest groups in each economic sector. During the consultation process, panels received views from about 10,000 people through workshops, interviews, conferences, etc. The design of Delphi questionnaire and the definition of Delphi topic statements were followed by the field study surveying about 3000 experts on topics concerning the future technologies in 15 sectors (for further details, see Refs. [3,4,13]).

In spite of a wider consultation from experts, the findings of Delphi survey had no significant impact on the final reports of many of the panels [4]. Anderson [4] cites the following statement from House of Commons S&T Committee, "indeed, the Delphi survey was found to alienate its respondents rather than involving them in the Foresight process." Then, he adds, "this was probably because of the way the questionnaire was developed. There were too many questions, and many of the 3000 experts who responded felt they were unable to reply sensibly most of them" (p. 668). These statements remind us both complex characteristics of foresight study and weaknesses of human being, as we mentioned above. Below, we will have closer a look to Delphi questionnaire to highlight confrontations better.

The second UK Foresight program started in April 1999 with a different format from the 1995 one, because the first exercise could not meet the expectations. In this program, thematic and sectoral panels were not asked to participate in widespread exercises like Delphi. Instead, they were independent to conduct their works without a structured framework, except start and finishing dates [1]. A key feature of this round of foresight is the way that various communities and groups have been encouraged and helped to undertake their own foresight exercise and to identify their own vision of the future and how they might prepare for it.

The second cycle of national foresight program included increased role for the business and regions for the implementation of foresight outcomes. Thus, in 1999, a "Business and Regions" unit was set up within OST Foresight Directorate, and regional development agencies (RDA) were established.

In the second exercise, it is noticeable that linkages between business and regions were established to enhance the capability of implementation of foresight results. Miles and Keenan [14] state that "it is interesting to note the linkage between business and regions with regard to foresight implementation—the OST had long difficulties in reaching the business community, especially SMEs, and it was believed that the regions offered one of the best 'levels' at which this could be achieved" (p. 21).

Regarding the implementation process after the first foresight exercise, there were several potential impediment points that easily transformed to obstacles in the implementation of foresight outcomes. To give an example: one of the points is the multiplicity of participants in foresight studies with different goals and objectives and with different implementation approaches. This point brought together another problematic point as the clear influence of political agenda on the implementation of foresight outcomes. According to Loveridge [1], "implementation demonstrates how the outcomes of foresight programs can be used in surprising ways according to political agendas, be they in government or in companies... The success of implementation in (the UK) government departments was haphazard. Many carried forward areas relating to their own remits, e.g., transport and the environment, but these were usually done through interaction with individual sector panels rather than at a program level" (pp. 128–134).

Here, the time horizon of foresight becomes a critical issue. Slaughter [15] criticizes the mechanical interpretation of the "present" and states that the "present" is socially constructed and depends on the purpose of the time frame. However, the short time frame always attracts attention of those who look for immediate compensation, profit or wish to carry out particular political agenda.

Public awareness of foresight studies and their outcomes is noteworthy at this point, which should be considered from the very beginning of foresight studies, in preforesight process. In the UK foresight studies, foresight had very limited audience. Loveridge [1] sees this as "the least satisfactory symptom of implementation" (p. 134).

In Section 4, we will overview the challenges in implementing foresight, which were faced considerably in above-mentioned foresight exercises.

4. Challenges in implementing foresight

As a process, implementation puts foresight outcomes into practice in two ways:

1. As *policy outcomes* for national science and technology, or social programs, depending on the objective functions set for the program, and

2. As *concrete outcomes* for companies in all sectors in the form of market trends, product, process and underpinning science and technology to facilitate development of company's business [1, p. 106].

However, these outcomes may not be reached because of the characteristics of foresight studies we ordered above. These characteristics introduce several challenges and impediments to the implementation of foresight results. Glenn and Gordon [16], Bryson et al. [17] and Gilbert [18] acknowledge several obstacles to the implementation of foresight outcomes, reflecting foresight's complex and conflicting characteristics. These obstacles dominantly underline structural and behavioral aspects.

The obstacles reflecting structural problems are mainly related with the management of part–whole relations and internal and external environments, which should be linked advantageously. Strategic, political, financial and informational factors are the ones that can be mentioned in structural problems.

1. Strategic problems are because of lack of clear-cut strategy and goals and lack of coordinated actions among players.
2. Political problems occur if the proposed action interferes with national, regional or organizational interests or if a political opponent has proposed it. Lack of involvement of regions, corporations and specific groups such as third sector is another reason of the occurrence of political problems.
3. Financial problems rise because of lack of funding or the fact that the people who ought to pay are unwilling to do so.
4. Information deficiency is another structural problem that arises if there is a lack of accurate, reliable and sufficient data and information. Uncertainty of the risk, conflicting information and lack of coordinated scanning are also among the reasons that cause information deficiency.

The structural problems cannot be overcome without transformative behaviors. The most difficult problems can be solved only through institutional transformation of behaviors. Slaughter [15] prescribes organizations to put more effort on people and behavioral issues in order to increase its application on the social level. However, there are also various obstacles to behavioral transformation. These obstacles are mainly related with human and organizational behaviors, planning inadequacy, complexity and lack of consensus.

1. The human problem is connected with the management of attention and commitment. The attention of key people must be focused on key issues, decisions, conflicts and policy references at key places in the process of organizational hierarchy. Behavioral transformations cannot happen without strong leadership.
2. Planning inadequacy occurs because of lack of long-term view. Near-term issues mostly gain more attention than those that have more distant future consequences.
3. Complexity is a critical issue, because decision-makers may not understand the complexities of the issues they must decide: lack of understanding of the magnitude of

problems, lack of models showing complex interdependence of events and policies and lack of understanding of consequences of action. Stereotypical thinking prevents the behavioral transformation required.

4. Lack of consensus emerges because of differing interests and ideology among key actors, politicians, the public and particularly the lobbying groups. During the foresight study, the consensus may not be appropriate to promote differences and to stimulate novel ideas. However, starting to any meaningful initiative requires consensus among individuals and groups controlling resources such as funds.

As a consequence, people and structures make the difference [19]. In order to adapt to a changing world, we must know how to change our structures, behavior and habits. However, the human mind has difficulty in dealing with complex systems that involve multiple interactions occurring simultaneously (see Ref. [20] for the three weaknesses of human being). "The opportunities for human error increase exponentially as the size and complexity of systems grow" [5, p. 130].

When these deficiencies in the UK foresight programs and the implementation of their outcomes are analyzed concurrently, the reflections of above-mentioned challenges and obstacles can be noticed. The failures are due to the lack of comprehensive and systemic approach and as a consequence of failure to anticipate the implications of change in one part of an interconnected system [21]. This is also valid not only in postforesight implementation stage but also during preforesight and foresight stages[3]. In their empirical work, Martin and Irvine [22] emphasize that many foresight efforts failed because insufficient attention was given to the preforesight or postforesight phase. This is why implementation of foresight studies should be taken into consideration from the design phase.

In the design stage, there should be an explicit understanding of how to use the foresight outcome. We suggest four criteria[4] that implementation stage in foresight should strive for:

1. Claritas,
2. Unitas,
3. Integrates,
4. Consonante.

While *Claritas* indicates the clarity and limpidness, *Unitas* represents the unity of the foresight. *Integrates* is about the integration and the totality. Finally, *Consonante* represents the coherence, harmony and acceptability of the foresight as a whole. The application of these four criteria prevents the conflict among participants and stakeholders while helping the dissemination of the decisions taken in society in a more understandable way with a broad participation.

[3] Martin and Irvine [22] distinguished three phases of foresight as *preforesight*, *foresight* and *postforesight*.

[4] Joyce [23] mentioned these criteria in his book *Portrait of the Artist as a Young Man* to criticize an art piece.

In the light of these criteria drawn above, two models are proposed in this study. Both of these models are based on systems approach that we employ to manage complexity in foresight.

The first model (the IMM) is employed to present an architecture for structuring multidimensional management issues, while roadmapping is used as a tool to decrease complexity in foresight process by capturing, visualizing, manipulating and managing information and by constructing roadmaps. In Section 5, we will present these two models that will help us to decrease the level of complexity in foresight studies.

5. Suggested methodologies

5.1. Integrated management model

Consisting of a set of interrelated elements, IMM is conceptually based on systems approach. The model is principally the predecessor of Ulrich and Krieg's [24] St. Gallen Management Concept. It presents an integrative and holistic way to structure management issues [25].

IMM assumes that the nature of the problem cannot be understood separate from its solution. The model presents a framework that is consistent with this assumption. Bleicher [25] built the integrated management concept on three management levels that Ulrich [26] defined as normative (higher management level), strategic (middle management level) and operational (lower management model) and three management components consisting of goals, structures and behaviors (Fig. 3).

The IMM indicates following basic notions of systems approach [27,28]:

1. IMM conceives management as a *multidimensional* process. It brings three components of management together as goals, structures and behaviors.
2. In logical terms, management is a *multilevel* process in IMM with normative, strategic and operational levels.
3. The framework of the IMM is *integrative* and brings three management levels and three management components in a 3 × 3 matrix to create a more complex picture.

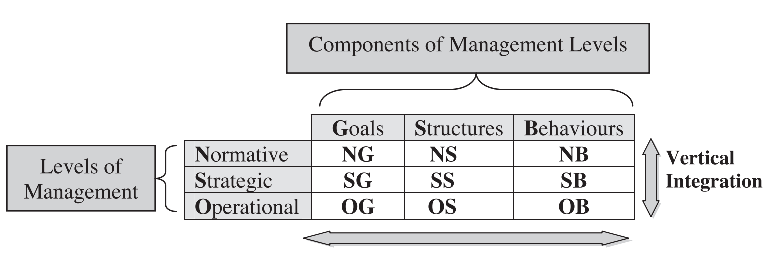

Fig. 3. Integrated management matrix. Source: Ref. [25].

4. IMM sees management as a *recursive* process. In principle, the whole scheme applies to any level of recursion of an organization.
5. All the components and levels constituting framework are *dynamically interrelated*.

In terms of management components, the basic consideration of the model is based on the premise that management activities influence the organizational activities. The determination of goals is followed by the manipulation of organizational structures and determination and creation of basic behavioral patterns in three management levels.

In the IMM, goals might be quantitative, qualitative or both. The forming, steering and development activities are related with the goals. Structures cover both the order of elements in a system and their relationships and the instruments for the generation of such arrangements.

Finally, by reflecting "soft" characteristic of the model, behaviors comprise internal, social and cultural aspects and the integration of the organization with its environment. Behaviors encompass cognitive, emotional and territorial interplay [29]. The model provides a perspective to understand the human aspects of designing, controlling and developing social systems.

IMM presents a multidimensional model consistent with the Linstone's "Multiple Perspective Concept." In Multiple Perspective Concept, Linstone et al. [30] propose a multiple outlook with three different types of perspectives in addressing complex problems. Although single perspective can only be used for bounded and well-structured problems, multiple perspectives can provide more insights in the complex and ill-defined problem situations (Fig. 4).

According to Mitroff and Linstone [5], "the value in using multiple perspectives lies in their ability to yield unique insights. None by itself suffices to deal with a complex system, but together they give a richer base for decision and action. Using a single perspective may be compared with employing a single dimension to depict a three-dimensional object. Each added dimension facilitates comprehension... The difference in perspectives forces us to distinguish how we are looking from what we are looking at. Each incorporates distinct sets of underlying assumptions and values" (p. 104).

In his model, Linstone [31] suggests the following interconnected perspectives:

1. T: the technical perspective,
2. O: the organizational and societal perspective, and
3. P: the personal and individual perspective.

Providing these three perspectives in his model, Linstone's assumption is based on real-life situations where problems are managed in at least three activities:

1. analyzing alternatives,
2. making decisions about which alternative to choose, and
3. successfully implementing the chosen alternative.

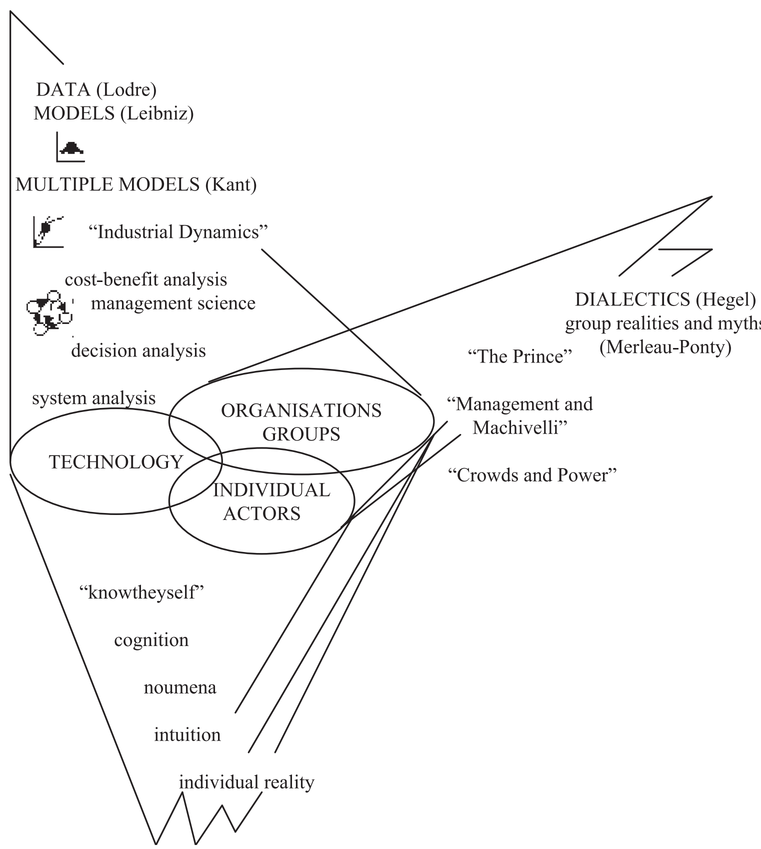

Fig. 4. Multiple perspectives (redrawn from Ref. [31], p. 66).

According to Mitroff and Linstone [5], "the T perspective focuses most strongly on (1) and least on (3); hence, the 'gap' so often deplored between analysis and action. Successful implementation depends first and foremost on the use of human resources, and this means that O and P become crucial as we move from (1) to (3)" (p. 102). By stressing the P perspective, they place emphasize on ethics and aesthetics, which is one of the most vital aspects of every problem. They suggest that the decisions should be made at the intersection point of these three aspects (Fig. 5).

This assumption is also reflected by IMM's management components (goals, structures and behaviors), which have significant consistencies with Linstone's "Multiple Perspective Concept." If there is a failure in one part of this interconnected system, this will cause other problems in other parts of the system and will become a system problem at the end. "... T solutions to T problems become the O problems of the next go around, and vice versa" [5, p. 104].

In the IMM, organization manages itself in three logical management levels, namely normative, strategic and operational. While the normative management level fulfills the

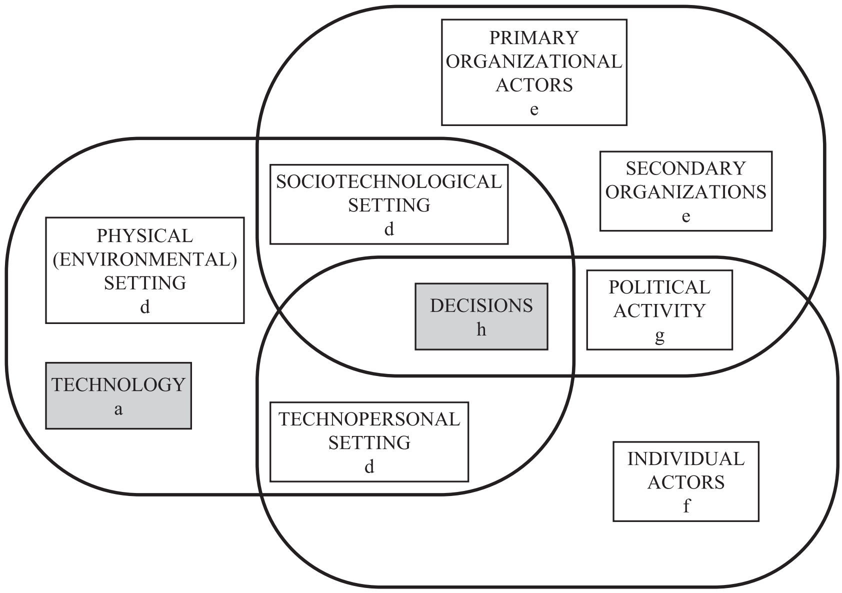

Fig. 5. The interconnections between three aspects. Source: Ref. [30], p. 290.

Conception function, the strategic management level executes the *Clarification* and orientation functions. Finally, the operational management level carries the function on *Implementation* and realization (see Fig. 7).

Normative management level is concerned with the viability and further development. This level clarifies desired values and norms in the light of expectations, desires and wishes and transforms these into policies. It should be recognized that futures studies, through the various futures methodologies and by the use of the range of future techniques, are linked inextricably with strategic planning and consequent organizational management.

Strategic thinking must precede creating of corporate or collective vision and selection of the organization's desired future position. Aiming the creation of value potentials [27], the strategic management is a broader and more encompassing umbrella [32]. "The concern here is for the disposition of resources at the appropriate time during the program; those dispositions for implementation need to be formulated during early stages of the program along with appropriate contingencies" [1, pp. 139–140].

In the operational level, implementation is simply putting the tested solution to work. At this level, resources are allocated in greater detail and the program is managed daily. The focus of operational level is the value creation (see Fig. 6). This is the reason why it is important to keep program on time, under planned budget, while following the schedule successfully. As we emphasized before, implementation is not something tacked on to the end of the modeling phase. It must be prime concern underlying all earlier steps in the analysis. Planning for

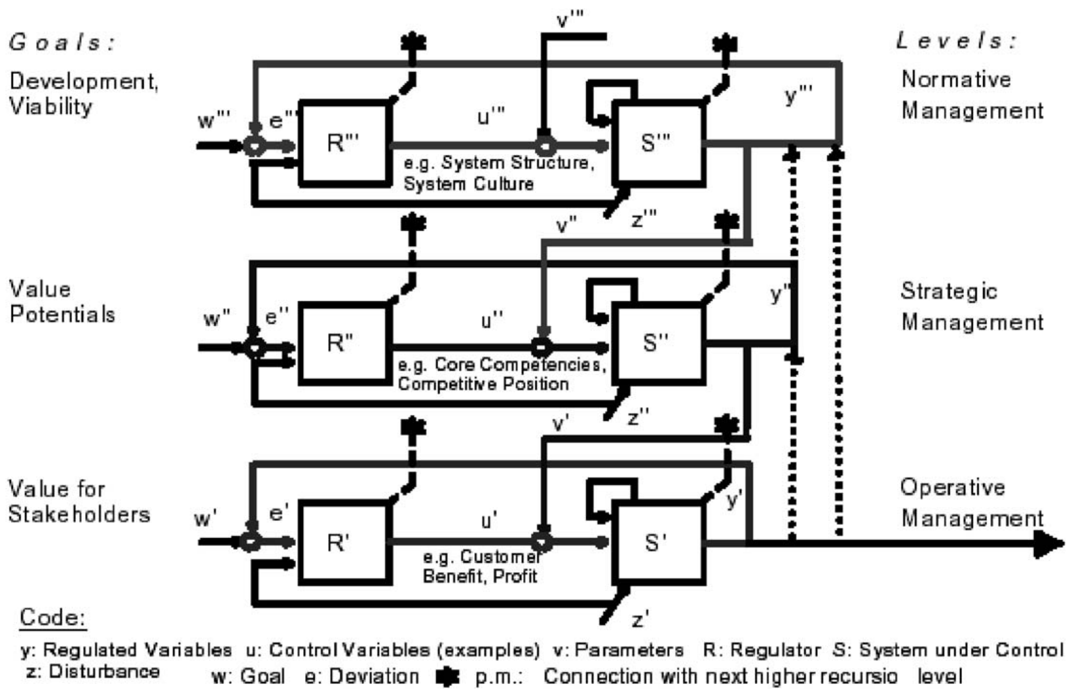

Fig. 6. Integral management as a multilevel control and feedback cycle. Source: Ref. [27], p. 145.

implementation starts right from the beginning of any project. We also emphasized previously that the process of implementation is fraught with difficulties that are largely of a human nature.

According to IMM, the upper management levels exert a precontrol function for the lower levels. Schwaninger [27] acknowledges *precontrol* as an anticipative creation of prerequisites at a higher logical level for effective control at lower levels of management. Additionally, the lower levels influence the upper levels in a *feedback* mechanism that might both widen and narrow the borders of the organization. In logical terms, the strategic level offers a metalanguage to operational level and the normative to the strategic and the operational levels.

In IMM, overall system performance depends critically on how well management components and levels fit and work together, not merely on how well each performs when considered independently. Therefore, each cell of the matrix should be taken into consideration in order to sustain the viability of the organization. The *balance* that Linstone et al. [30] mentions for his Multiple Perspective Concept's perspectives (*technical*, *organizational* and *personal*) is also valid for between IMM's management components and management levels. "Individuals with strong bias towards analysis, such as engineers and scientists, are more likely to spend an excessive, if not obsessive, proportion of their time with T, with which they are comfortable, and threat O and P as superficial addenda...In obtaining information, recognize that O and P require greatly different methods than T" [5, p. 108]. Mitroff and Linstone [5] also state that the structured questionnaires or Delphi are not substitute for direct interviews where O and P become especially critical in understanding other cultures.

As Beer [33] stated, an organization is viable if and only if it disposes of a set of management functions with a specific set of interrelationships, identified and formalized. Any deficiencies in the system, such as missing functions, insufficient capacity of the functions or faults in communications or interactions between them, impair or jeopardize the viability of organization. The viability, cohesion and self-organization of an enterprise depend on these functions being recursively present at all levels of the organization.

As a consequence, in the application of IMM, not only the multiple perspective approach between management components will be employed but also the integration between foresight and its implementation through strategic planning will be considered to decrease the level of complexity.

5.2. Roadmapping

The very complex nature of foresight studies points to the existence of very large number of nodes (Delphi events) and dynamic relationships between these events. In order to decrease the level of complexity and to overcome human beings' weakness of restricted information processing capability, we propose the use of roadmapping to develop roadmaps.

The roadmap is selected set of requirements, links and R&D projects that describes the state of technology development and potential transfer in a coherent area. It could be composed of a single requirement for a system linked to corresponding R&D projects, or it could encompass multiple requirements linked to numerous projects.

Constructing the roadmap framework (i.e., identifying the specific nodes to be used in the roadmap and the placement of these nodes at the appropriate level of development) is perhaps the most challenging step in the roadmap development process. The appropriate expertise must be employed to develop a roadmap. The quality and credibility of roadmap increases as more experts are employed in its construction.

Placement of foresight conversion step into a larger pathway from research to higher payoff applications is a key component for eliciting stakeholder interest in foresight studies. While much attention has been given to the development of Delphi events (future requirements) in foresight studies, relatively few efforts have focused on fusing together requirements with research systematically, which would enable foresight stakeholders to start initiatives for the implementation of foresight results.

Identically, a little progress has been made on methodologies to identify the characteristics of the linkages between Delphi events. There are fundamental reasons of this. The pathways between research and eventual applications ("practical use" and "widespread use" in UK foresight) are many, not necessarily linear and require an enormous amount of data for any attempt to link research with application. Substantial time and effort are required to portray these links as accurately as possible, and substantial thought is necessary to articulate and portray the massive amount of data in a form comprehensible to potential investors.

Establishing the link between requirements and eventual implementation and starting initiatives were among major problems that the UK foresight studies experienced. In an OECD meeting in 1994, Walshe [34] noticed this point by stating that "the real challenges will be to get private industry to engage in fruitful partnerships with academia..." (p. 187). Williams confirmed Walshe's *foresighted* concerns by stating that "the UK has a poor track record of developing and commercializing basic research. This has led to a position where much research has to find at least partial support from the private sector. It also recognizes that in the end it is largely the private sector that will have to take the initiative in investing in and commercializing results, hence overall approach of involving all of the partners and the emphasis on the process of participation, dialogue and meeting rather than on any forecast of 'critical technologies'" [12, p. 100].

The main value of this decision aid or roadmaps, in the foresight conversion process, would be to promote stakeholder (champion/investor) interest in developing the research further at all phases of the roadmap development process. In planning the roadmaps, experts in different levels of development and payoff become involved, and the risks, potential costs and benefits are clarified further. When the completed roadmap is distributed to interested parties, decisions to pursue the foresight conversion can be made with greater understanding of the longer development context.

Roadmaps are constructed at four levels:

1. Research,
2. Development,
3. Capability, and
4. Requirement (the future requirements are the subjects of today's research areas).

Research and development levels represent existing or proposed research programs and development programs. The capability level nodes represent target capabilities for which there is a consensus that successful program development could result. Finally, the requirement level represents existing or potential needs set. The parallelism between these levels and the terms used in the 1995 UK Technology Foresight Study—*Elucidation*, *Development*, *Practical use* and *Widespread use*—is noteworthy.

Successfully transferring technology to customers (linking *Elucidation* and *Widespread use*) through a succession of autonomous development groups requires extraordinary coordination. There are many opportunities for technology transfer to become stalled at any point along the way by disparate priorities among the groups. Depicting these agreements or issues in a graphical model discloses to the entire research, development and customer community the potential transfer points where obstacles to technology transfer at any stage of technology development or requirements specification may occur [35]. Recognizing these differences and taking corrective action is the best way to overcome conflict among stakeholders. Priorities for requirements or technology project funding can serve as a basis for reexamining funding allocations, and an awareness of emerging technologies can be provided to foresight stakeholders.

As an important component of integrated foresight management, roadmaps force the developers to clarify conceptual strategic targets in order to represent them graphically. Awareness of all the contributors to R&D required and R&D available in other sectors of the technical community is increased, sometimes dramatically. In particular, critical path research can be identified, and support for its accelerated development can be strengthened. The main value at this phase is to the developers themselves; additional value accrues when the completed roadmap is provided to external users.

In the application of roadmapping to the UK foresight exercises, we employed graphical modeling system (GMS). Developed by U.S. Navy Research Center, GMS visually portrays requirements, capabilities, R&D projects in different development phases, relationships between R&D projects and requirements and integration among R&D projects [36]. Several other algorithms have been developed that link research programs to end uses/capabilities/requirements.

In the classical matrix approach developed by Dean, impacts flow monolithically upward in the development chain (research → technology → capabilities → requirements/end targets) [36]. In the network/directed graph approach, impacts are allowed to flow upward, downward or laterally in the development chain (e.g., research → technology → research → research → technology → capabilities) [37]. GMS is able to show node–link relationships of both matrix and network approaches where a research or technology project or a capability is treated as a node in the network, and the impact of one project (node) on another project (node) is portrayed as a quantified link in the network.

In GMS, the nodes (projects/capabilities/requirements) are treated as multivalued (multi-attributed) quantities and are allowed to exist in many different research–requirement pathways simultaneously. This capability provides a more accurate depiction of the multi-application rate of most research and technology. It allows identifying the special potential applications to which a research project could lead. It also allows stakeholders to identify the research and technology projects, which presently serve as obstacles to reaching desired applications targets in a timely manner. Researchers can observe the larger context in which their work is being performed or identify new applications targets for their research and make informed decisions on how to proceed to maximize payoff for multiple applications. Users are able to identify more cost-effective alternatives, or even research gaps, for accomplishing their applications of interest [36]. In very complex systems, it might be useful to construct several roadmaps to make the process more understandable.

6. Application of the methodologies to the UK foresight exercises

In this section, the paper presents reevaluation of the results of the 1994–1995 UK Foresight Delphi survey and 1999–2000 UK foresight scenarios. In this study, we examined construction Delphi questionnaire and scenarios. The only particular reason that we chose construction industry is our background information on the nature of the industry. However, the methodologies we proposed are generic and can be used to guide and analyze foresight studies in every scale and subject. By reevaluating UK foresight studies, our aim is to raise some considerations and problematic points confronting the successful implementation of foresight outcomes from systems perspective.

In the present study, we propose that scenarios and Delphi events should be considered in a complementary stance. In order to indicate the proposed relationship between scenarios and Delphi events, we give place to the UK construction foresight scenarios developed in the second cycle of foresight program in the UK. We will not analyze the outcomes of second foresight program as much in detail as we will Delphi results. Rather, we will place more emphasis on the complementary natures of scenarios and Delphi and the necessity to use both of these techniques in an integrated way rather than replacing one with another.

6.1. 1995 UK Delphi results

The construction sector Delphi questionnaire consisted of 80 topic statements under 11 subsectors (Table 1). The respondents time horizon on topic statements varied between short and medium terms. According to experts, the realization time of 50% of the topics is between 1995 and 2004 [13]. According to Loveridge et al. [13], there were "uncertain" and "often conflicting" opinions for the realization time of the topics. They state that, "the ranking of the top 10 topics needs to be examined with caution when interdependent factors, of which *Period of occurrence* is one, are taken into account" (p. 176).

In the questionnaire, there is a dominance of *Widespread use* topics. Then, *Development* and *Practical use* topics follow. However, there is only one *Elucidation* topic, which is not shown in the original table (see Table 1). The rest of the topics in the questionnaire are *Other* topics.

Table 1
Subsectors and classification of topics in 1995 UK construction foresight [13]

Subsector title	Number of topics	Topic number range	Elucidation[a]	Development	Practical use	Widespread use
Buildings in use[b]	21	1–21	1		2	12
Changing client demands	4	22–25				3
Design	5	26–30			1	4
Finance and funding	2	31–32				
Land use	5	33–37			1	3
Materials	8	38–45		4		3
Productivity improvement	6	46–51				4
Quality of life	3	52–54				2
Regulations	8	55–62				
Safety and security	5	63–67		1		3
Sustainable development	13	68–80		3	2	7
Totals	80		1	8	6	41

[a] Elucidation was not indicated in original table.

[b] See Appendix A for the consolidated UK Delphi results of "Buildings in use" subsector from Rounds 1 and 2, including all respondents.

Table 2
Respondents average degree of expertise

Level of expertise	Average degree of expertise (%)	Standard deviation (%)
Familiar (Level 3)	60.6	8.4
Knowledgeable (Level 4)	28.6	6.4
Expert (Level 5)	10.7	4.7

According to our point of view, lack of elucidation topics means there is a difficulty in translating future requirements into R&D projects and initiatives. In the topic statements, more emphasis is placed on action rather than theoretical understanding of the underlying science of matters relating to building and construction practice.

The degree of expertise is also an important indicator in terms of evaluation of Delphi results. In construction sector Delphi, most of the experts were "familiar" with the subjects. The distributions of the averages of expertise are shown in Table 2, with the values quoted from Loveridge et al. [13].

Below, we reevaluate the results of Delphi survey with systems approach. First of all, we will show the complex relationships between sectors, subsectors and events in the Delphi survey and will reclassify them. After the analysis of the sequential relationships between Delphi events, we will balance them by using IMM. Then, we will reformulate Delphi events by employing roadmapping and will show how roadmaps can be used for the identification of new events.

6.1.1. Classification of sectors, subsectors and events

In this section, we will discuss the results of construction Delphi from a systems perspective. Our focus will be on *Buildings in use* subsector. We will highlight several impediments to the timely use and successful implementation of foresight results.

The first point that we place emphasis here is the complex picture appeared when the relationships between Delphi subsectors were considered. One representation of the relationships between the subsectors is depicted in Fig. 7[5]. The figure is useful to highlight the degree of dynamic complexity among subsectors in the Delphi survey.

Moreover, Fig. 8 similarly indicates very complex relationships between Delphi events in the Delphi questionnaire. Nevertheless, it is clear that the degree of complexity is much higher compared with the previous figure, indicating the relationships between subsectors.

From these two pictures, it should be expected that any participant in the foresight study (expert or not) will definitely have problems in correctly evaluating Delphi events if they are not exposed to complex structures shown in Figs. 7 and 8. These pictures are helpful to

[5] Figs. 7 and 8 were drawn by using GMS software's data management and display tools. However, the roadmaps were constructed by judgement.

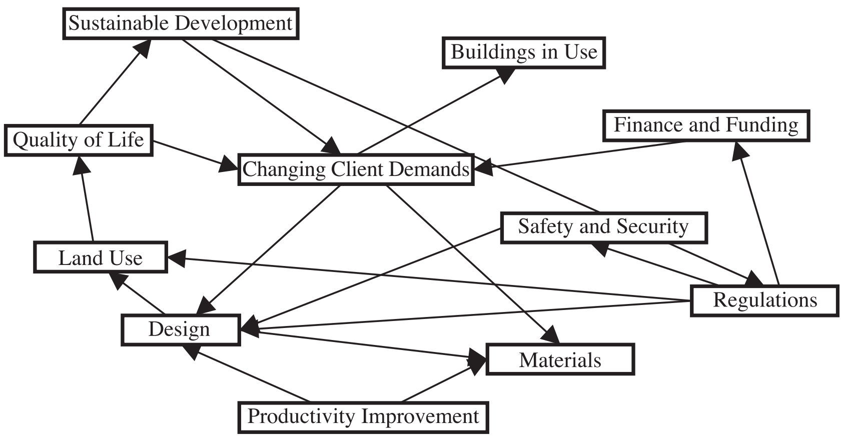

Fig. 7. Very complex relationships between UK construction foresight subsectors.

acknowledge Anderson's [4] evaluations in postforesight study period. "... Experts who responded (to the questionnaire) felt they were unable to reply sensibly most of them." This will obviously cast doubt on the validity or reliability or meaning of Delphi survey results (see Ref. [5] for the reliability and validity of Delphi as an "inductive-consensual inquiry system"). The natural outcome of this situation will be the difficulty in defining and starting initiatives on the way to a desired future.

In this study, we propose that subsectors and their relationships should be defined from the developed scenarios in advance of Delphi. In the current classification of sectors and subsectors, there is a need for a hierarchy between sectors and subsectors. Doing this exercise for the UK foresight, we would choose sustainable development not as a subsector but as the main theme of the foresight study. Only then the two main sectors would be the "Quality of life" and "Wealth creation." An illustration of our proposed hierarchy is below (see Fig. 9).

In the figure, the relationship between sectors and subsectors were indicated. Although the "Wealth creation" and "Quality of life" groups are not independent on one another, we preferred to indicate them separately. The relationship between "Wealth creation" and "Quality of life" are shown with the causal relationship between subsectors. We suggest that for the clarity of topic statements, sector and subsector definitions should be well defined. On the other hand, we propose that the participants should see the dynamic relationship and dependency between subsectors, so as sectors.

The appropriate definition of sectors and subsectors and their relationships should be followed by formulation of events (topic statements). The events to be used in Delphi should be formulated in accordance with scenarios developed. Scenarios and the events that scenarios contain should communicate interactively in a network/directed roadmap approach. In this approach, impacts flow upward, downward or laterally in the development chain (e.g., topics → scenarios → roadmaps → reflection → events) and take into account the dynamic relationship between scenarios, roadmaps and events.

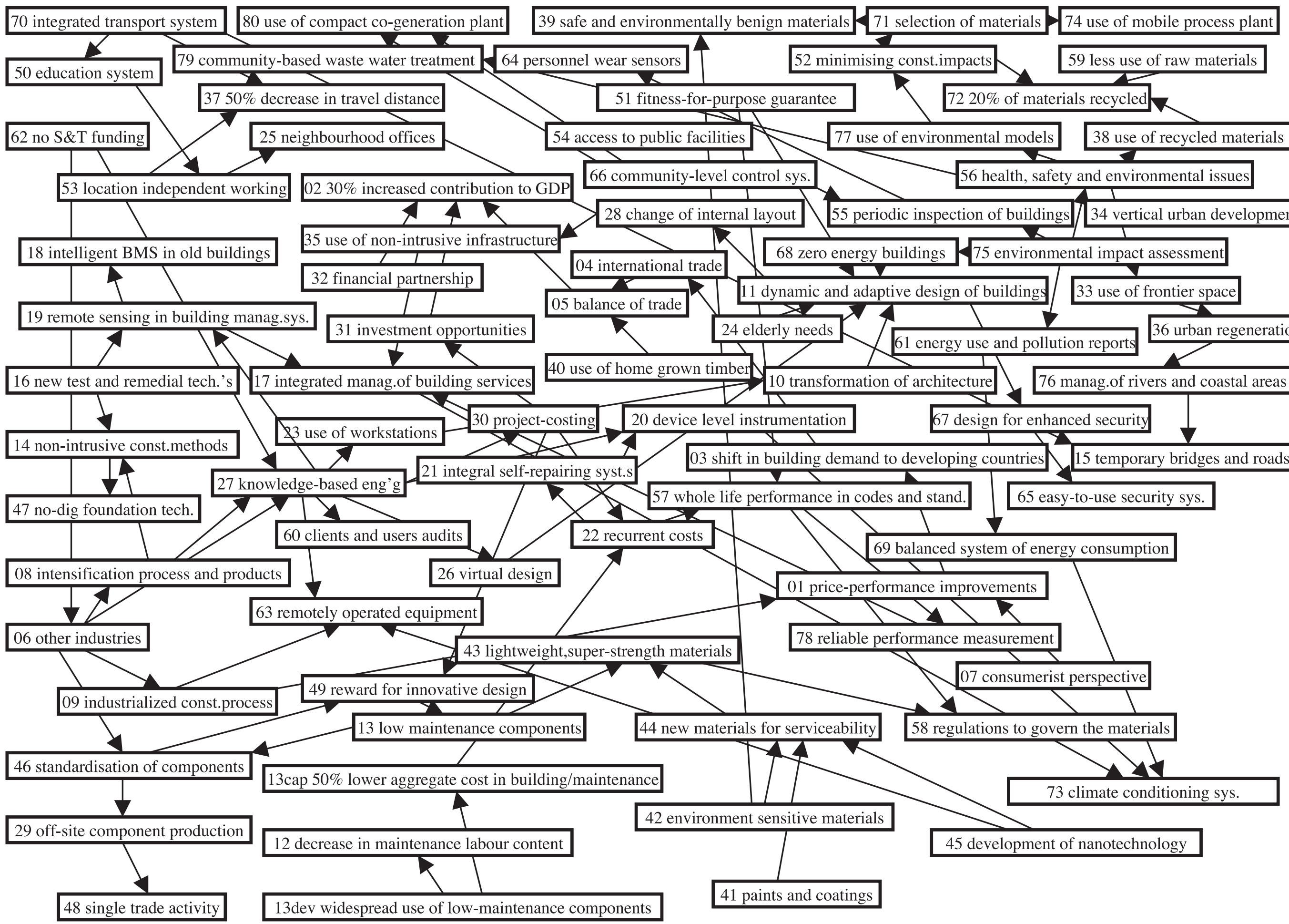

Fig. 8. Very complex relationships between UK construction foresight Delphi events.

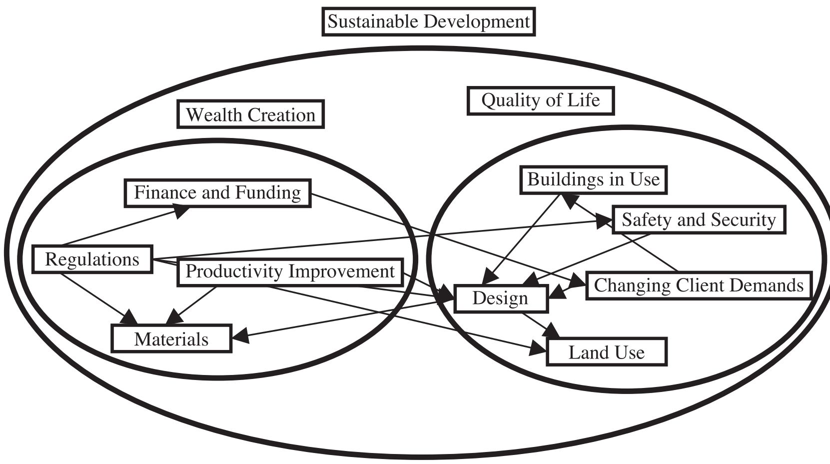

Fig. 9. Modified relationships between sectors and subsectors.

6.1.2. Analysis of Delphi events

When we approach a Delphi questionnaire with a systemic perspective, we expect to see a relationship between events, because all these events and statements are parts of an interconnected whole and some of them are prerequisites for others' realization.

In order to see these causal relationships between the UK Delphi events, we calculated the average realization year of each event in *Buildings in use* subsector. The methodology we used in the calculation of average year of realization (AYR) can be found in Appendix B. The results of our average realization year calculations are indicated in Table 3.

From the table, we notice that both the lack of established systemic causal relationships between events and the human's third weakness, "limited information processing capability" prevented the experts to see the interconnections between the events. To give an example, lets take Event 10 (Architecture is transformed through the further elucidation of the relationships between people, space and places) and Event 11 (Buildings are designed as dynamic and adaptive structures able to adjust automatically to the many and varied pressures of people and nature).

Between these two events, the first one is prerequisite for the second one. In order to design dynamic and adaptive structures, there is need for change in the behaviors of designers by understanding people, their future necessities and interaction with space, places and nature. Nevertheless, when we check their weighted AYR, we see that while the realization time of Event 10 is 2024, the realization time of Event 11 is 2014. In this case, we would venture to claim that had the participants been notified on the logical relationship between these two events, their assessments would have probably changed.

Readers who do not want to use average years of realization can also see Fig. 10, which shows distributions of expert's answers into time periods for interrelated Events 9–12 as they were given in Delphi survey results (see Appendix A). If the causal relationships between events were established before and if the participants had chance

Table 3
Buildings in use subsector events' years of realization

2029	21. Building components with integral, self-repairing systems are in practical use in critical application areas.
2027	5. The UK balance of trade for construction materials, components and services combined move out of deficit into credit.
	6. Industries that have not been associated traditionally with construction create a growing proportion of the built environment (e.g., car manufacturers build houses, telecommunications companies build offices and banks build roads).
2024	2. The contribution of buildings and structures to UK gross domestic product increase by 30% on present levels.
	10. Architecture is transformed through the further elucidation of the relationships between people, space and places.
2023	7. Expectations that a building should last for decades, and even centuries, are replaced by a consumerist perspective, and most buildings and structures are designed for specific function over a much truncated lifespan.
2020	9. Construction is transformed from a craft-based activity to a wholly industrialized process, drawing in full on the principles of science and engineering.
2017	4. International trade is a significant component of all but the smallest UK construction firms' work portfolios.
2016	1. Improvements in the price performance of buildings and structures facilitate an acceleration in the long-run rate of renewal of the UK's building stock to double the present rate.
2014	11. Buildings are designed as dynamic and adaptive structures able to adjust automatically to the many and varied pressures of people and nature.
	14. Practical use of nonintrusive construction methods eliminates the disruption and consequential costs associated with the maintenance of infrastructural services.
2012	13. Widespread use of low-maintenance components and materials reduces the aggregate costs of building maintenance by as much as 50%.
	15. Temporary bridges and roads are commonly used to enable essential maintenance and upgrading to be pursued with little or no disruption of traffic flow.
	20. Major building elements and subsystems include device level instrumentation to provide information on condition and performance in real time.
2011	18. Intelligent building management systems (IBMS) are routinely used in older, "nonintelligent" buildings.
2010	3. Demand for buildings and structures shifts from developed to developing countries, as the full effects of the world demographic explosion work themselves out.
2008	8. Construction firms, including SMEs and sole traders, experience a dramatic intensification in the technical content of both the building process and the building products in all major markets.
	12. Widespread use of standardized, modular, easy-to-fit components greatly reduces the labor content of commercial and domestic maintenance work.
2005	16. Widespread use of new test and remedial technologies extends the useful life of existing buildings.
2004	19. Building management systems make widespread use of remote sensing devices.
2003	17. Management of building services is integrated, in most commercial properties, with the management of facilities (e.g., space configuration or RMI).

to examine this scheme, their answers would not be that conflicting and there would not be an intersection between the lines in Fig. 10 because of the sequential relationships between events.

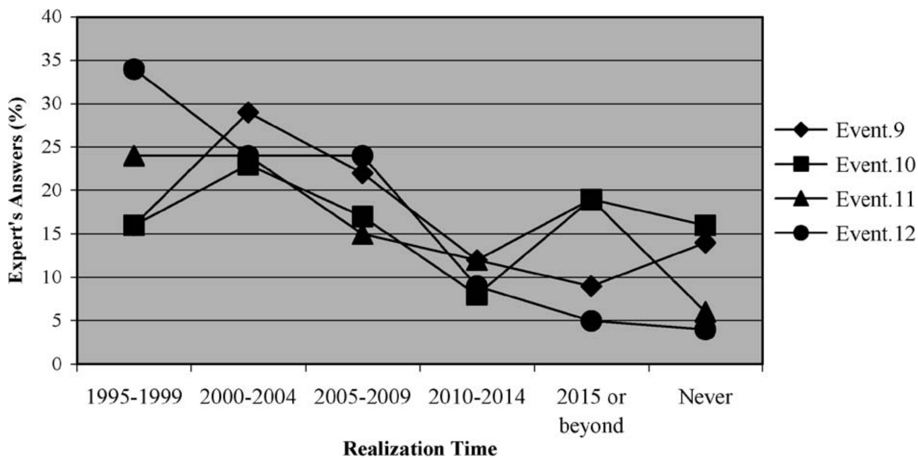

Fig. 10. Expert's answers for the period of occurrence of four events.

6.1.3. Balancing Delphi events

With the term "balance," we intend what Linstone mentions in his Multiple Perspective Concept's perspectives (*technical*, *organizational* and *personal*). We propose a balance between IMM constituents as he proposes among T, O and P perspectives, because overall system performance depends critically on how well management components and levels fit and work together, not merely on how well each performs when considered independently. Therefore, each cell of the 3×3 matrix should be taken into consideration in order to sustain the viability of the organization.

For a successful change process from goal definition to implementation of the results, the foresight Delphi events should cover all cells in a balanced manner. Our first attempt to place 80 construction industry Delphi events into the cells of the matrix resulted in Table 4.

Here, we do not suggest numerical equality between the cells of matrix but a balance by considering each cells in the construction of Delphi events. For instance, the lack of events, which focus on behavioral change of individuals, poses a threat to the understanding and successful implementation of foresight results. In this way of thinking, the design becomes part of the solution.

Table 4
Distribution of UK Delphi events in integrated management matrix cells

	Goals	Structures	Behavior
Normative	1, 2, 11, 33, 68, 70, 75	3, 5–10, 28, 38–40, 45, 52–54, 57	23, 50, 56, 77
Strategic	24, 31, 34–37, 66, 69, 71, 72, 79	4, 13, 14, 16, 17, 22, 29, 32, 42, 43, 46, 48, 51, 55, 58, 62, 63, 76, 78	12, 27, 49, 60
Operational	25, 65, 67, 73, 74, 80	15, 18–21, 30, 41, 47, 59, 61, 64	26, 44

Table 5
Balancing UK Delphi events with IMM

	Goals	Structures	Behavior
Normative	What?/Why?	9. Construction is transformed from a craft-based activity to a wholly industrialized process, drawing in full on the principles of science and engineering.	Who?/Why?
Strategic	What?/When?	6. Industries that have not been associated traditionally with construction create a growing proportion of the built environment (e.g., car manufacturers build houses, telecommunications companies build offices and banks build roads).	10. Architecture is transformed through the further elucidation of the relationships between people, space and places.
Operational	What?/How?	12. Widespread use of standardized, modular, easy-to-fit components greatly reduces the labor content of commercial and domestic maintenance work. 8. Construction firms, including SMEs and sole traders, experience a dramatic intensification in the technical content of both the building process and the building products in all major markets.	Who?/How?

In order to make the ambiguous distribution above clearer and understandable, below we will give an example to see the missing points in the Delphi events (see Table 5). The empty cells should be filled properly in the guidance of the questions given in the table.

In this study, we suggest that the Delphi events should be formulated by keeping in mind the IMM framework. Successful implementation of "balanced" foresight results requires the definition of useful initiatives. To do this, we propose roadmapping as a complementary methodology.

6.1.4. Reformulating Delphi events and roadmapping

In *Practical Guide to Regional Foresight in the United Kingdom*, Miles and Keenan [14] underline that "the events (in 1995 UK Delphi survey) were often poorly attended and there were difficulties in "translating" national foresight "messages" into a language that SMEs could easily relate to" (p. 21). Roadmapping is used to reformulate the Delphi events and to translate future's requirements (foresight messages) to today's R&D projects (initiatives for SMEs and other stakeholders in the society). In this sense, we propose four interrelated steps to construct roadmaps:

1. Definition of future *requirements* by foresight
2. Coming back from the future, decision on the *capabilities* needed

Table 6
Roadmap components of some UK Delphi events

UK Delphi events	Identified components of UK Delphi events
1. Improvements in the price performance of buildings and structures facilitate an acceleration in the long-run rate of renewal of the UK's building stock to double the present rate.	(req) an acceleration in the long-run rate of renewal of the UK's building stock (cap) to double the present rate (dev) improvements in the price performance of buildings and structures (this can be a requirement as well—lower cost per square meter by 50% can be its capability) (res)
2. The contribution of buildings and structures to UK gross domestic product increase by 30% on present levels.	(req) the contribution of buildings and structures to UK gross domestic product (cap) increase by 30% on present levels (dev) (res)
5. The UK balance of trade for construction materials, components and services combined move out of deficit into credit.	(req) the UK balance of trade for construction materials, components and services combined (cap) move out of deficit into credit (dev) (res)
6. Industries that have not been associated traditionally with construction industry create a growing proportion of the built environment (e.g., car manufacturers build houses, telecommunications companies build offices, and banks build roads).	(req) industries that have not been associated traditionally with construction industry create growing proportion of the built environment (cap) (dev) (res)
7. Expectations that a building should last for decades, and even centuries, are replaced by a consumerist perspective and most buildings and structures are designed for a specific function over a much truncated lifespan.	(req) expectations that a building should last for decades, and even centuries, are replaced by a consumerist perspective (cap) over a much truncated lifespan (dev) most buildings and structures are designed for a specific function (res)
9. Construction is transformed from a craft-based activity to a wholly industrialized process, drawing in full on the principles of science and engineering.	(req) construction is transformed from a craft-based activity to a wholly industrialized process (cap) (dev) drawing in full on the principles of science and engineering (res)
12. Widespread use of standardized, modular, easy-to-fit components greatly reduces the labor content of commercial and domestic maintenance work.	(req) reduces the labor content of commercial and domestic maintenance work (cap) (dev) widespread use of standardized, modular, easy-to-fit components greatly (res)
13. Widespread use of low-maintenance components and materials reduces the aggregate costs of building maintenance by as much as 50%.	(req) reduces the aggregate costs of building maintenance (cap) by as much as 50% (dev) widespread use of low-maintenance components and materials (res)

3. Definition of *development* areas in order to reach desired levels of target capabilities
4. Description of *research* projects in defined development areas.

Table 6 illustrates the components that selected UK Delphi events from the *Buildings in use* subsector carried. When we examine the table, we see that Delphi events contained two or three (out of four) components of a roadmap that we ordered above. None of these Delphi events include *research*. For the technology development process to take place, we need R&D projects. Research and development cover not only the improvement of novel technologies but also adoption of a current technology from one field to another. Lack of R&D makes it very difficult to promote stakeholder (champion/investor) interest in developing the research further. Much research has to find at least partial support from the private sector because, in the end, it is largely the private sector that will have to take the initiative in investing in and commercializing results. The UK Delphi was not very successful in developing and commercializing basic research.

Roadmaps can lead to identification of new events to include and provide the basis for construction of programs and plans for meeting goals. Fig. 11 below shows an example of constructing Delphi events by using roadmaps. The figure shows the breakdown and completion of Event 43 (Development of lightweight, superstrength materials to reduce construction time significantly) into components, which would help as a facilitator in starting initiatives, thus implementation of foresight results. In this event statement, "to reduce construction time significantly" is actually another requirement, which would probably depend on other capabilities, development areas and successful completion of multiple research projects.

Another critical point while constructing Delphi events is the use of ambiguous explanations. In the construction of the event statements, one needs to be extremely

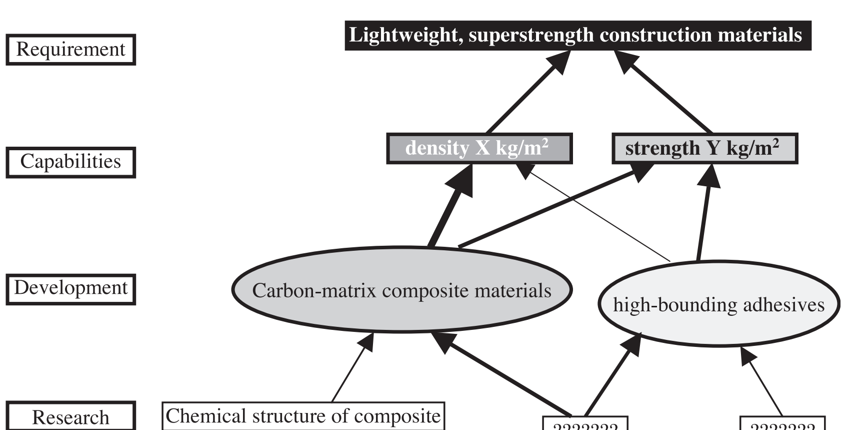

Fig. 11. Identifying Delphi events by using GMS.

careful in not causing any misunderstandings and ambiguities. Pilot foresight studies in Turkey revealed that the Delphi event statements such as "... to double the present rate" does not mean much, because even some experts are not aware of the actual value of present data/situation (see Refs. [38–45] for pilot studies in Turkey). Although many authors highlighted this point previously, we wanted to place emphasis again because of criticality.

6.2. 2000 UK foresight scenarios

In the present study, we propose that scenarios and Delphi events should be considered in a complementary stance. In order to indicate the proposed relationship between scenarios and Delphi events, we give place to two scenarios presented in a consultation paper titled "Building our Future" [46]. The scenarios indicate a number of possible outcomes that may result from the way society develops over the next 20 years. Including a poor and a positive outlook, these scenarios are extremes. The details of the scenarios can be found in Appendix C. Below, we summarize these scenarios.

Scenario 1: A poor outlook
From failure to act:

1. Uncoordinated planning, in-filling of greenfield gaps
2. Increased traffic congestion and impact on health
3. Poor quality of life for the elderly
4. Frustration for the young, resulting in increased crime
5. Increase in "cowboy" builders and the "black economy"
6. Outmoded construction industry, poor quality employees.

Scenario 2: A positive outlook
From an active response to the key issues:

1. Wide use of information systems for personal and community benefit
2. People nearer to work, less stressed and with improved health
3. Better planning, less "greenfield" impact
4. Coordinated construction, lower costs and reduced energy
5. Reduction in "cowboy" builders and the "black economy"
6. Greater international competitiveness for the industry.

In our analysis, we noticed that there is a direct relationship between the 2000 scenario statements and the 1995 Delphi event statements. When the Delphi statements and scenarios are considered simultaneously, it is noted that scenarios capture some of the events in Delphi survey with an *expansionist* manner by showing them as parts of the same narrative.

For example, Event 9 in Delphi survey states that "construction is transformed from a craft-based activity to a wholly industrialized process, drawing in full on the principles of science and engineering." Similarly, in the scenarios, this event is stated in a sentence as follows: "... it was true that these days they only needed 50 people on subcontract because most of the work was made up of components prefabricated off-site and assembled on site by robots."

Another scenario statement captures at least two of the Delphi statements together: "... The moment that the environmental control system problem was indicated then the hospital computer system had notified the local authority's system, which alerted the construction management company and they sent an engineer to assess the problem in detail and repair it. The management company was surprised that the problem had not already been picked up on their regular remote scanning of the system's in-built sensors." The same issue is found with a more abstract explanation in the Delphi survey in Events 19 and 20. The statement of Event 19 is "Building management systems make widespread use of remote sensing devices" and Event 20 completes the rest of the story explained in scenario: "Major building elements and subsystems include device level instrumentation to provide information on condition and performance in real time."

At this point, the question arises on the timing and the roles of scenarios in foresight studies. From this point, we will expand a new proposal below where we present a systems approach to foresight process as a whole by integrating scenario planning, Delphi and roadmapping under the guidance of IMM.

6.3. A final approach: joint use of scenarios, Delphi and roadmapping under IMM guidance

As it can be noticed from the above analyses, scenarios present a more complete picture by indicating the relationships between events in the Delphi survey in a real-world condition. This is the reason why it is easier for nonexpert people to understand what the future will look like. This makes participation of wider stakeholders more possible. However, in the second step, when the capabilities and R&D projects are discussed, we need Delphi reinforced with roadmaps with a higher level of technical, organizational and behavioral expertise in order to create initiatives in the society.

Here, we suggest a two-part Delphi survey enhanced with scenario writing and roadmapping between them. In this approach, there are upward, downward or lateral interactions in the foresight development chain (e.g., topics → scenarios → roadmaps → events). Honeywell's prominent "planning assistance through technical evaluation of relevance numbers" (PATTERN) scheme can be considered as a precursor of this approach.

PATTERN scheme suggests development of scenarios to assess national objectives, activities, missions, etc., then construction of relevance trees from the findings of scenarios. Meanwhile, technology forecasting is made. In forecasting, two sets of characteristics are addressed explicitly: cross support and status and timing for systems and subsystems. Then, "snapshots" are created through the computer program used (see Ref. [47] for details).

Our proposed approach—two-part Delphi together with scenario writing and roadmapping between them—takes into account the dynamic complex relationship between scenarios and events and events themselves throughout the process under the guidance of IMM's multiple management levels and components.

In this process, the first Delphi survey should aim for utmost participation from the general public in order to determine the general characteristics of the desired future. The next step we propose is to write up scenarios from these Delphi results and have an extended discussion of these scenarios in the society. The outcome of this step would be a prioritization of components of the desired futures—*requirements* (see Ref. [48] for prioritization).

The third step of our approach would then be to have expert panels to convert requirements into capabilities, development areas and research projects by employing roadmapping with GMS (or any other compatible tool). Roadmaps that define paths to meet future requirements can assist to find nodes about which more information is required. This approach is akin to "technology sequence analysis" (TSA) that "involves the statistical combination of estimates of the time required to achieve intermediate technological steps." TSA reminds "project evaluation review technique" (PERT) approach, which "is a method to organize in the most efficient sequence a variety of tasks to accomplish a goal," in a general sense the consistency between TSA and our proposed approach because of TSA's view to the future "as a series of interlocking, causal steps or decisions (nodes) leading to some future state" and use of expertise to design networks and time intervals between nodes [49, pp. 1–2].

The next step requires construction of a Delphi questionnaire with the aim of gaining this information by using appropriate expertise. During the Delphi process, roadmaps contribute the assessment of events as parts of larger interconnected whole with complex dynamic relationships between them. Here, a PERT-like chart, leading from present technologies to goals to identify the links between nodes for a "Monte Carlo"[6] method, can be beneficial (see Ref. [49] for details).

The last step includes again an extended discussion in the society for the resource (e.g., budget) allocation among the projects and initiatives identified at the end of the second Delphi survey. A method for prioritizing initiatives using Delphi results has been suggested by Oner and Sayan [50] and Sayan [41] and prioritizing R&D projects by Kaya [51].

7. Conclusions

In this paper, we discussed the reasons behind the difficulties encountered in using foresight results by analyzing 1995 and 2000 UK foresight results. The problem points

[6] "Monte Carlo" is the name of a method that involves random sampling. It is often used in operations research to analyze problems that cannot be modeled in closed forms [50, p. 4].

revealed that there is a necessity for transformation in understanding the foresight and its complex nature. Here, as Mitroff and Linstone [5] stated, "... the greatest transformation is to see the world as an interconnected whole" (p. 159) and looking at problems and issues from the perspective of nonseparability.

We noticed that the assessment of Delphi events composed of different sequential in-time components is very difficult. We tend to think that different respondents may evaluate the events by focusing on different components, which would introduce a major difficulty in assessing the results of Delphi survey. This leads us to the need for separating events into components (requirements, capabilities, development and research), which would facilitate roadmapping to be carried out by stakeholders who would convert foresight results into purposeful initiatives. It was quite interesting to notice that 1995 UK Delphi events included only one *elucidation* (research), which was not classified and reported.

The first model proposed in the study, namely IMM, offers a different and useful way of developing policies and strategies and their transformations into actions. It is a practical tool providing a complete picture that covers long-, medium- and short-term futures (normative, strategic and operational) with their components (goals, strategies and behaviors). A successful foresight study needs to have a balanced focus on management levels and their components.

In this new methodology, roadmapping is used as a facilitator of the IMM. As an effective tool, roadmaps are helpful, for instance, when constructing Delphi surveys and Delphi event statements in order to make connections between future's requirements and today's research areas by constructing roadmaps.

The roadmap contributes to the consensus that the mission is desirable and achievable. It provides a strong impetus for championing the accelerated development of essential research. The value of the graphical models is that they show R&D projects and requirements in context rather than in isolation, they can depict new perspectives rapidly and they can serve as a focal point for enhanced communications and more detailed total systems analyses.

The last point that we emphasized is the joint and systemic use of different techniques rather than focusing on one such as joint use of scenarios and Delphi. We tried to illustrate that scenarios are helpful to create a complete picture of the future that is helpful for society to understand the future scene without stuck on technical details and to participate. In addition, Delphi can be used to convert requirements defined in scenarios to capabilities and R&D projects with the support of roadmaps that could relate individual events and contribute for the interconnected and interrelated whole.

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Appendix A. Consolidated 1995 UK Delphi results from Rounds 1 and 2: all respondents

Topic Statement	No. of Respondents	Degree of expertise					Degree of impact on wealth creation				Degree of impact on quality of life				Period within which the event will have first occurred						Necessity of collaboration			
		1	2	3	4	5	1	2	3	4	1	2	3	4	1995-99	2000-04	2005-09	2010-14	2015-...	Never	None	Within	Europe	Global
1. Improvements in the price-performance of buildings and structures facilitate an acceleration in the long run rate of renewal of the UK's building stock to double the present rate.	163	18	34	29	14	6	1	17	64	18	7	24	45	24	15	31	22	9	14	9	10	56	42	22
2. The contribution of buildings and structures to UK Gross Domestic Product increase by 30% on present levels.	162	29	28	28	11	4	1	26	52	22	7	37	40	16	10	23	26	15	8	18	15	66	26	11
3. Demand for buildings and structures shifts from developed to developing countries as the full effects of the world demographic explosion work themselves out.	171	17	40	26	14	3	6	23	49	22	4	29	42	24	23	31	24	7	10	5	4	14	25	87
4. International trade is a significant component of all but the smallest construction firms' portfolios.	178	12	35	37	11	5	1	10	54	35	3	50	38	10	29	29	10	8	12	12	7	32	34	61
5. The UK balance of trade for construction materials, components and services combined move out of deficit into credit.	169	22	38	26	10	4	1	7	51	41	3	45	41	11	10	20	30	7	14	20	5	52	37	38
6. Industries that have not been associated traditionally with construction create a growing proportion of the built environment (e.g. car manufacturers build houses, telecommunications companies build offices and banks builds roads)	171	21	32	33	8	6	11	42	34	13	10	58	24	8	17	34	11	6	9	23	26	41	34	32
7. Expectations that a building should last for decades, and even centuries, are replaced by a consumerist perspective and most buildings and structures are designed for specific function over a much truncated life-span.	176	8	23	37	20	12	10	30	47	12	37	29	27	7	27	26	12	5	12	18	27	43	30	24
8. Construction firms, including SMEs and sole traders, experience a dramatic intensification in the technical content of both the building process and building products in all major markets.	174	13	21	33	24	9	5	20	58	17	5	36	45	14	37	31	17	6	4	5	9	48	52	33
9. Construction is transformed from a craft-based activity to a wholly-industrialised process, drawing in full on the principles of science and engineering.	181	6	19	34	29	12	4	22	53	21	19	33	35	12	16	29	22	12	9	14	6	55	55	33
10. Architecture is transformed through the further elucidation of the relationships between people, space and places.	161	19	30	27	15	9	4	54	34	8	2	16	43	38	16	23	17	8	19	16	17	44	34	42
11. Buildings are designed as dynamic and adaptive structures able to adjust automatically to the many and varied pressures of people and nature.	167	14	22	33	20	10	3	29	50	18	0	14	56	30	24	24	15	12	19	6	8	49	45	44
12. Widespread use of standardised, modular, easy to fit components greatly reduces the labour content of commercial and domestic maintenance work.	168	9	19	30	31	11	3	29	48	20	5	40	42	13	34	24	24	9	5	4	8	48	55	26
13. Widespread use of low-maintenance components and materials reduces the aggregate costs of building maintenance by as much as 50%.	164	9	22	38	20	11	3	23	49	25	1	33	50	17	16	33	23	11	11	6	7	48	53	35

Topic Statement	UKís current position versus other countries: Scientific and technological capacity			Innovation capacity			Production or service delivery capacity			Exploitation & Commercialisation potential			Constraints on occurrence in UK						
	Leading edge	Average performer	Lagging behind	Leading edge	Average performer	Lagging behind	Leading edge	Average performer	Lagging behind	Leading edge	Average performer	Lagging behind	Social/Ethical acceptability	Technological feasibility	Industrial/ Commercial	Lack of funding	Economic viability	Regulatory/Policy/ Standards	Educational/Skill base
1.	7	60	33	12	60	28	1	57	41	3	52	45	25	13	38	60	34	35	47
2.	5	66	28	6	68	26	5	60	35	3	65	32	28	10	32	57	40	30	36
3.	22	63	15	19	69	13	11	70	19	7	64	29	21	9	44	50	50	12	41
4.	19	59	22	17	64	19	14	58	28	10	55	35	20	11	55	29	40	21	47
5.	10	45	45	15	43	42	2	42	55	2	41	57	11	21	67	46	40	24	40
6.	10	60	31	11	55	34	6	57	37	4	52	43	28	19	55	20	42	26	38
7.	17	67	16	27	57	17	7	69	24	6	66	27	70	14	36	18	37	43	19
8.	15	61	24	15	64	21	3	64	32	3	59	59	18	33	41	46	35	27	71
9.	13	55	32	17	59	25	4	62	34	5	57	39	46	38	36	37	28	21	66
10.	20	59	21	31	50	19	12	68	20	8	57	36	48	16	24	33	29	24	60
11.	22	60	18	24	61	15	8	70	21	6	56	38	27	46	36	40	47	33	44
12.	9	73	19	19	70	12	9	69	21	3	65	32	33	34	44	26	39	33	41
13.	13	67	20	17	64	19	5	67	27	2	68	30	15	37	45	33	45	25	48

Appendix A (*continued*)

Topic Statement	No. of Respondents	Degree of expertise					Degree of impact on wealth creation				Degree of impact on quality of life				Period within which the event will have first occurred						Necessity of collaboration				UKís current position versus other countries												Constraints on occurrence in UK						
																									Scientific and technological capacity			Innovation capacity			Production or service delivery capacity			Exploitation & Commercialisation potential									
		1	2	3	4	5	1	2	3	4	1	2	3	4	1995-99	2000-04	2005-09	2010-14	2015-...	Never	None	Within	Europe	Global	Leading edge	Average performer	Lagging behind	Leading edge	Average performer	Lagging behind	Leading edge	Average performer	Lagging behind	Leading edge	Average performer	Lagging behind	Social/Ethical acceptability	Technological feasibility	Industrial/ Commercial	Lack of funding	Economic viability	Regulatory/Policy/ Standards	Educational/Skill base
14. Practical use of non-intrusive construction methods eliminate the disruption and consequential costs associated with the maintenance of infrastructural services.	158	22	25	32	18	4	2	35	51	12	0	16	60	24	22	28	17	16	12	7	8	53	49	31	15	60	25	23	59	18	3	72	25	4	65	31	7	52	33	34	52	24	28
15. Temporary bridges and roads are commonly used to enable essential maintenance and upgrading to be pursued with little or no disruption of traffic flow.	156	22	34	23	16	5	5	44	43	8	2	18	56	24	42	26	10	7	6	9	27	60	14	12	21	72	7	27	65	8	11	74	15	6	75	19	14	22	28	28	50	35	16
16. Widespread use of new test and remedial technologies extends the useful life of existing buildings.	158	18	30	30	17	5	1	32	51	16	0	38	47	15	34	31	20	9	3	2	15	50	45	31	26	65	9	24	67	10	6	80	15	3	76	21	7	43	34	41	46	30	38
17. Management of building services is integrated, in most commercial properties, with the management of facilities (e.g. space configuration or RMI)	155	25	21	37	11	6	2	40	47	11	2	30	49	18	46	29	13	7	5	1	16	58	36	20	24	66	10	21	66	13	11	74	15	9	71	20	14	28	35	26	39	13	48
18. Intelligent building management systems (IBMS) are routinely used in older, 'non-intelligent' buildings.	157	25	29	30	11	6	2	46	43	9	2	25	62	12	23	33	13	19	8	5	16	57	32	22	17	61	22	19	66	15	6	67	27	8	63	29	9	48	32	31	69	15	38
19. Building management systems make widespread use of remote sensing devices.	158	22	31	28	11	8	2	42	47	9	1	38	46	15	39	37	11	10	2	2	14	53	42	29	26	57	17	23	65	12	12	67	21	10	67	24	12	38	27	33	62	19	33
20. Major building elements and sub-systems include device level instrumentation to provide information on condition and performance in real-time.	155	25	32	25	10	9	1	54	38	7	0	52	38	10	18	28	21	14	14	5	7	50	45	32	20	64	16	21	62	17	7	64	29	4	64	32	9	47	31	34	57	15	34
21. Building components with integral, self-repairing systems are in practical use in critical application areas.	140	47	26	16	9	2	3	51	35	11	3	50	39	8	4	13	21	10	38	15	9	38	47	52	8	66	26	15	63	23	2	68	30	1	64	34	3	82	22	42	62	21	39

Table 7
Calculation of an event's year of realization

Years	1997	2002	2007	2012	2030	2100	2023 (AYR)
p	27	26	12	5	12	18	100 (Σp)
Years**p*	53,919	52,052	24,084	10,060	24,360	37,800	202,275 (ΣYears*p)

Appendix B. Calculation of average year of realization

In our calculations of AYR, we used the following equations and assumptions:

$$\mathrm{AYR} = (1997{*}p1 + 2002{*}p2 + 2007{*}p3 + 2012{*}p4 + 2030{*}p5 + 2100{*}p6)/\Sigma p$$

In the formula, p represents the percent distribution of responses for each time period. 1997 is the midpoint of 1995–1999 (years given in the Delphi questionnaire), 2002 is the 2000–2004, etc., 2030 is used for 2015 and beyond. The problem in this case is we have no chance of knowing what are the participant's thoughts when choosing this answer. Finally, the answer "never" has been quantified as 2100. Here, even an expert cannot foresee with his present level of knowledge that "something will never take place."

Although 1997, 2002, 2007 and 2012 are midpoints of the time periods given in questionnaire, 2030 and 2100 are the years that we proposed in this study. We tested the significance of these years by replacing 2030 with 2020 and 2040 and then 2100 with 2200. Because there was no significant difference, we selected 2030 and 2100 in our analysis. Table 7 below shows an example of calculations for Event 7.

Appendix C. Scenarios of 1999 UK construction foresight

C.1. Southlands

At the sound of the 6:00 am alarm from his digiwatch, Simon kicks his feet over the side of bed and sighs. By 8:00 am, he is due at the Southlands construction site on the North Downs near Guildford, where his firm is building a new 200-acre industrial and office complex and link roads. The site is only 15 miles away from his old Edwardian house in Kingston-upon-Thames, but unless he leaves by 7:00 he might be late for the meeting.

It is just as well he is not travelling into the center of London, for it takes forever by car, and then he is only allowed to go as far as Hammersmith, from where he would have to take the tube that is always crowded. Anyway, the inner-city environmental tax means that it all costs a fortune.

Simon is the project manager for the Southlands development, and everyday seems to bring a new crop of problems. Today, he has a meeting with the subcontractors to determine why some of them have different sets of plans. He knows the clients wanted last minute changes in order to cut the infrastructure costs, but it was not clear when the changes were made or who authorized them. The architects were also unsure as they had upgraded to a different computer package recently and had not advised Simon, so they were working with different software and yesterday he found that he could not access the information over the Internet.

Last week, it was group of local "environmental warriors" protesting about the lack of progress in earthworks screening that was supposed to have been in place before construction started 6 months ago and about how "he" had cut down trees that they thought were to have been preserved. They did not understand that he was not the one who gave permission for the development to be built on the edge of the Downs in preference to redeveloping an old industrial complex somewhere and that he did not design it and that he could not be everywhere at once to supervise the subcontractors either—even though most of the 200 guys on the site needed it. Half of them did not know a trowel from a plumb line, but then that was to be expected. Finding skilled tradesmen these days was almost impossible. Most school leavers, except for the least able, wanted to work with self-intelligent computers, not get their hands dirty on a building site. Anyway, he had enough problems everyday, chasing deliveries, querying missing and ill-fitting components, resolving disputes and dealing with the HSE over the five accidents they already had since the work started.

Having voice activated the coffee maker whilst he was shaving, Simon carried the two cups of coffee into the bedroom and gently shook Noola from her sleep. It was all right for her. She was not on duty at the hospital until 2:00 pm.

Noola worked as a nursing sister at the local hospital, just 2 miles and 10 minutes away in the car. When she was on days she cycled, because parking at the hospital, even for staff, was expensive. However, when she was on the evening shift, it was safer to take the car. To get to the hospital, she had to skirt the old housing estate, which should have been pulled down years ago but which, because of the low rents, now housed mostly younger single men and a few single-parent families.

It was from one of the nearby private detached houses that poor old Mrs. Willoughby had yesterday been brought into Noola's ward. She was suffering from respiratory problems caused by some chemicals that had been seeping through her living room wall.

Mrs. Willoughby was only 74 and a widow. Her husband Don had died over 15 years earlier, and these days her son rarely came to visit. However, although she lived alone, Mrs. Willoughby was not well off. All she had was her basic state pension, and that almost was not enough to pay her normal bills, let alone maintain the house, but she was too proud to ask for help. Her house was damp and the roof is in need of repair. Worse, the environmental control system she had spent most of her remaining savings on 3 years previously had not been working properly for the past 18 months. Whenever she switched it on, it got too hot and humid, then after a while it plummeted the temperature so low that she either had to go out into the garden to get warm—where she was often frightened by the noisy youths nearby—or she had to put on an extra layer of clothes and go to bed. Now, she did not use the system very often. She had tried complaining to the builder who had installed it and put the intelligent cladding onto the walls, but he denied responsibility. Anyway, he said, she had paid him cash, had not she! You cannot have an expensive e-con system at almost cost price and expect guarantees beyond 12 months, can you!

Noola felt sorry for her when the story came out. A similar thing had happened at the hospital when they refurbished it. Well, at least their e-con system worked, but it had apparently tripled the electricity bills and so most of the time it was switched off. Unfortunately, Mrs. Willoughby's respiration problems were also exacerbated by some sort of long-term chemical buildup, which may have come from the e-con cladding.

Noola sighed and blew Simon a kiss as he headed out of the door for work. He probably would not be back until about the same time as she got home from work in the late evening. Her thoughts drifted back to Mrs. Willoughby. She hoped she was going to recover, although she might have to be taken into care and her house sold. Mind you, Noola thought, who would want to buy the house in the state it was in. There was already a glut of old rundown houses around, most of which were only good for low cost private renting.

C.2. Greenacres

At the sound of the 7:00 am alarm from his digiwatch, Simon kicks his feet over the side of the bed and grins. By 8:00 am, he is due on-line to the site controller at the Greenacres construction site near Wandsworth, just outside London, where the consortium of which he is part is constructing an integrated residential, shopping, entertainment and office complex as part of a major redevelopment of the area. The site is only 6 miles away from his neatly refurbished house in Kingston-upon-Thames, although he does not need to visit it everyday. Simon controls most of the project from home, over the Internet, using remote video conferencing for daily briefings, supported by on-screen, computer-based documentation, which automatically updates the records of everyone in the consortium the moment any changes are made. It means that all records are always compatible and all changes carry an explanation. Once a week, Simon does travel to the site, despite the fact that he can examine the work visually from home using a virtual reality simulation "walk-through" with live remote CCTV updating to examine the detail. He can also check building progress at home from the computer-produced daily schedule of component deliveries and the automatic audit of robot construction activities. Travelling to the site once a week simply breaks the routine, particularly as he can choose what time of the day to go, thus avoiding the worst of the traffic, not that the trip is too bad these days. Public transport is so good that it is even a pleasure to go into the center of London, as he does once a month for an informal get-together with other members of the consortium.

Last week, he took a group of local environmental planners around the site to show them the progress that was being made. They were impressed with the open spaces that had been created around the separate groups of modular, flexible offices and homes. Trees had been planted and the gardens are laid for the first phase, and these would continue to be maintained regardless of who bought or rented the houses or offices in the future. It was all part of the lifelong maintenance contract that the consortium had put in place for the project; caring for the plants added to the environmental tax credits—the ECs—they earned. What with the extensive range of energy-efficient devices the architects had built into the project, and the decision to use the new solar-powered site robots, their ECs were already stacking up nicely and so far there had been no site accidents to mar the points they had earned.

The environmental group was amazed to find so few people on the site, although at the time some of them were in the site restaurant and rest area watching the lunchtime movie or doing part of their compulsory 2 hours a week of Continual Professional Development study. However, it was true that these days they only needed 50 people on subcontract because most of the work was made up of components prefabricated off-site and assembled on site by robots. Everybody was part of the profit-sharing consortium and all were skilled tradesmen and specialists in matters such as robot management, intelligent materials or—to meet the needs of some of the early renters and purchasers—experts in bespoke spatial component construction. Most of their on-site work was supported by the portable TV sensing and communications units they wore, and they all seemed to enjoy being able to work as they wandered around the site, particularly in the good weather that seemed to pervade Southern England these days.

Having voice activated the coffee maker whilst he was shaving, Simon carried the two cups of coffee into the bedroom and gently shook Noola from her sleep. She was on home visit duty at 10:30 am that morning. Noola worked as a visiting nursing sister for the newly rebuilt local hospital, just 2 miles and 10 minutes away on the comfortable local transit service that the hospital provided.

When she was on days or on home visits like today, Noola sometimes cycled, because the exercise was good for her and the cycle lanes ran right through the new housing estate, which had recently been given a four-star whole-life cost rating and was now part subsidized to provide low-rent starter homes for young families and self-care units for the elderly. The new design approach enabled blocks of living units to be easily and quickly altered for single-person living or for larger families.

It was at one of the nearby private detached houses that Noola planned to visit old Mrs. Willoughby today. She had recently been brought into Noola's ward for her annual checkup.

Once the detailed annual examination was over, most continuing health monitoring was usually through remote on-line diagnosis, but they had found that Mrs. Willoughby had a slightly reduced respiratory function. Mrs. Willoughby was 74 and a widow. Her husband had died over 15 years earlier, and her son worked in California and was rarely able to visit, so once a month the local family support unit helped Mrs. Willoughby through a face-to-face video meeting session with him. At her age, she struggled a bit with new technology.

The hospital had ordered a diagnostic check of Mrs. Willoughby's house the moment they discovered her reduced respiration. It revealed that there was a small problem with her environmental control system and it was not expelling sufficient moisture. The system had only been installed 18 months ago as part of the local authority's ongoing housing maintenance support scheme for the elderly. The scheme was subsidized by the local council because the nonreplacement whole-life maintenance value of the house more than justified it. The moment that the environmental control system problem was indicated then the hospital computer system had notified the local authority's system, which alerted the construction management company, and they sent an engineer to asses the problem in detail and repair it.

The management company was surprised that the problem had not already been picked up on their regular remote scanning of the system's in-built sensors. That was annoying because the problem was now going to debit goodness knows how many EDs—the environmental tax debits that always embarrassed them when the details were published in *Contract Journal*. Noola sighed and blew Simon a kiss as he headed across the landing into the office to work. Knowing him, he would still be there when she got back, although if she was lucky he might have stopped early enough to have the dinner ready. Now that would be a real treat!

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