



Towards a decision support tool for real estate management in the health sector using real options and scenario planning

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Abstract

Purpose – Uncertainties affecting health organizations inevitably influence real estate decisions since real estate is required to facilitate the primary health process. The purpose of this study is to develop a decision support tool that supports health organisations in defining what flexibility they need in order to develop a flexible real estate strategy and to adapt to future uncertainties.

Design/methodology/approach – The research is being conducted from a design science perspective. By addressing the needs of real estate managers in health, research relevance is reached. By applying scientific knowledge when developing the tool, rigor is achieved.

Findings – Major elements of the decision support tool developed are real options to describe flexibility and its consequences for corporate real estate management, and the backcasting scenario planning method.

Social implications – The application of the tool by health organisations can increase the professionalization of real estate management and improve the match between current and future demand and supply of real estate, adding to the effectiveness and efficiency in healthcare in general.

Originality/value – This is the first tool developed using the real options approach that provides real estate managers in health a systematic insight into the various types of flexibility needed for the future.

Keywords Healthcare real estate, Real options, Scenario planning, Backcasting, Decision support tool, Health care, Real estate

Paper type Conceptual paper

1. Introduction

Healthcare provision is changing rapidly due to demographic changes, financial pressures, medical/technological developments, and policy changes. Given the ageing population and consequent budget pressures, there will be strong pressure for more efficient healthcare systems. Governments and healthcare providers all over the world are looking for ways to cope with booming healthcare costs, and at the same time decrease governmental budgets.

To address these challenges, governments have introduced competition among healthcare providers. Marketization in the health sector is seen by some as essential to limit costs. In various European countries, marketization has received a new impulse, with new policies encouraging a more business-like operation in health organizations,

The hospital that participated in the workshop and the reviewers for their constructive comments are gratefully acknowledged.



resulting in an increasing importance being attached to efficient and professional real estate management. This implies a need for the strategic management of real estate, where the current and future demands within the organization are considered from the viewpoints of the asset owner and the asset user: the investor and the operator. New partnerships have to be developed among healthcare providers, building companies, and financiers.

An important issue within these partnerships for healthcare real estate management is flexibility, necessary because of the uncertainties surrounding future healthcare demands (Blanken, 2008; De Neufville *et al.*, 2008b; Rechel *et al.*, 2009). Flexibility can be enabled through technical solutions, design flexibility, flexibility during the construction process, or in the use of the building. Despite this need, no tool has been developed that provides real estate managers with insight into the various types and the amount of flexibility that is needed in the various phases of a project, both now and in the future. A promising approach to providing a more differentiated insight into how flexibility can be created, its value, and its consequences is the real options theory (Adner and Levinthal, 2004a, b; Gehner, 2008; Vlek and Kuijpers, 2005). Given the many uncertainties influencing healthcare, a combination with scenario planning forms a useful complement. This has already been proposed, such as by Miller and Waller (2003), but not yet applied in the context of real estate development. We have opted for the backcasting method since this facilitates the development of strategies (Dreborg, 1996), including ones that would be appropriate for real estate management.

The aim of this paper is to develop a decision support tool that is both rigorous and relevant. Rigor is achieved by conducting the research from a design science perspective (Van Aken, 2005). Hevner *et al.* (2004) developed a design framework based on this paradigm that we apply in this research (Figure 1). The decision support tool has relevance since it should support health organizations in defining what flexibility they need to adapt to future uncertainties. In the next section, we go deeper into the design framework. Following the various aspects of the framework shown in Figure 1, we then describe the organizational needs in Section 3, after which the applicable knowledge will be discussed in Section 4. In Section 5, the developed decision support tool, based on the established knowledge base, is presented and tested. We then conclude the paper with a discussion of the testing, evaluation, and implementation of the decision support tool in the healthcare field and recommendations for future research.

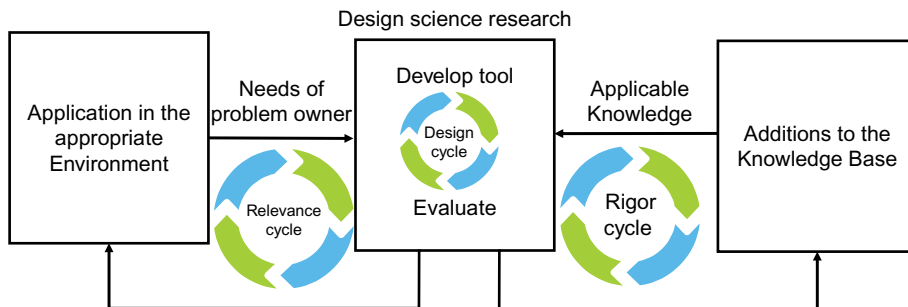


Figure 1. Research framework

Source: After Hevner (2007) and Hevner *et al.* (2004)

2. Research method

2.1 Design science

The aim of design science is to design technological rules that are solution-oriented (Romme, 2003; Van Aken, 2005). Technological rules can be formulated as “if you want to achieve Y in situation Z, then perform something like action X” (Van Aken, 2005, p. 23). The concept of the rule should be well grounded in research, but be applicable in different contexts. Field-testing can provide supporting evidence.

In the research framework of Hevner *et al.* (2004), the environment defines the application domain of the tool to be developed, and includes the people, the organizational and technical systems, and the problems and opportunities (Figure 1). By addressing these needs, the research achieves relevance. The knowledge base consists of the foundations (theories, methods, experience, and expertise). By applying this scientific knowledge, rigor is ensured. These two areas form the basis of the tool to be designed. Finding a solution involves a professional or researcher, in conjunction with the problem owner, and follows the regulative cycle of Van Strien (1997). This cycle roughly consists of defining the problem, planning the intervention (diagnosis, design of alternative solutions, and selection), applying the intervention, and evaluating the effect (Van Aken, 2004). By applying and replicating the tool in different cases but in the same context one accumulates supporting evidence which continues until “theoretical saturation” (Eisenhardt, 1989; Van Aken, 2004) has been obtained. When this point of saturation has been reached, the tool development process stops. A first test of the tool developed was done by means of a workshop, interviews before and after the workshop and by observations during the workshops. This resulted in various design propositions to improve the tool. These propositions are important since they recognize both driving and blocking mechanisms (instances where the design propositions will succeed or fail). These mechanisms are important when it comes to translating the propositions to other contexts (Van Aken, 2004).

3. Needs of the problem owner: flexibility in providing care facilities

As outlined in the introduction, the provision of healthcare is changing rapidly due to developments which are to an extent predictable, such as demographic changes, and sometimes very uncertain such as medical-technological innovations and policy changes. However, the buildings and the services provided within them are expected to support the core public service at all times. Strategic facilities management focuses on aligning buildings and ancillary services with the needs of the core business (Dewulf *et al.*, 2000). The extent to which the core services will change due to changing demands for clinical activities is unpredictable. The core business of a hospital, the clinical services, is changing rapidly, and therefore the need for flexibility has become increasingly important. This implies a need for greater flexibility in real estate strategies: in order to meet current and future supply and demand. Increased flexibility for a building’s client often implies greater risk for the contractor, and this will be factored into the pricing. Therefore, excessive flexibility should be avoided since the costs might outweigh the benefits. Further, flexibility can have mixed and even opposing consequences for the various stakeholders within an organization. In order to have the knowledge to determine what types and how much flexibility to negotiate for, greater insight is needed into the types of flexibility, when to use them, and how to create and exercise flexibility.

Flexibility is a broad concept (Olsson, 2006) and various types of flexibility can be identified. In this study, the categorization of flexibility in real estate management in health developed by the Dutch *Bouwcollege*[1] is followed, namely:

- financial flexibility – such as short-term rent contracts and marketability of real estate;
- organizational flexibility – using all spaces in an optimal way;
- process flexibility – in which the organization gains flexibility by staging the decision-making process; and
- product flexibility – in which technical applications facilitate building flexibility.

Blanken (2008, based on Yun (2007)) added flexibility on strategic, tactical, and operational levels. Strategic flexibility enables changes to the configuration of an asset to enable long-term real estate strategies. Tactical flexibility enables the building to be adapted without changing the overall size and functionality, while operational flexibility has a low impact on time such as changing furniture.

Different types of flexibility, or real options, can often be obtained by making certain investments. As such, there is a need for a decision support tool that considers the various types of real options. The tool should add to the professionalization of real estate management in healthcare and to greater cost effectiveness within healthcare in general.

4. Applicable knowledge

The knowledge base used in designing the decision support tool draws on both theory and practice. In this section, we discuss the theoretical concepts underlying the decision support tool. In Subsection 4.1, we go deeper into the concept of flexibility by applying the real option theory. Following this, Subsection 4.2 elaborates on scenario planning and the specific applicability in this research of various methods.

4.1 Flexibility and real options

A promising approach for providing insight into flexibility is the real options theory. A real option is defined as a right, not an obligation, to exercise an option, and the idea derives from financial options (Black and Scholes, 1973). Myers (1977) applied options to *real* investments: so-called real options (Dixit *et al.*, 1994; Amram and Kulatilaka, 1999). Real options provide value through the ability to be flexible, and the value increases as uncertainty increases. Triantis and Borison (2001) suggests various ways of applying real options: as a way of thinking, as an analytical tool, and as an organizational process. We argue that using real options, as a way of thinking and as a basis for real option analysis (ROA – see Adner and Levinthal, 2004a, b; Leiblein, 2003), is the most promising application in a healthcare context for three reasons. First, real options, as a way of thinking, can help real estate managers recognize that uncertainty is not inherently negative, and can even provide value. Second, since many uncertainties in healthcare are unpredictable and therefore impossible to quantify, ROA provides a method to assess uncertainties in an easy and qualitative way that does not require competence in handling complicated risk analysis tools. The other advantage we highlight is that the categorization of real options forms a practical tool to identify the types of flexibility needed and the mechanisms that can be mobilized to create this flexibility. In this way, ROA provides a language of flexibility that facilitates

communication between different decision-making levels. For example, the project management team of an organization can more easily provide insights for the board of the organization into the consequences of certain decisions.

Although research show that practitioners often unconsciously reason according to the real option concept, real option models are only limitedly applied. Authors such as Triantis (2005) argue that real option models should be more user-friendly and that, to improve risk management practices, the gap between unconsciously and consciously using real option thinking should be closed. Triantis (2005) suggests that the development of heuristics would aid the further dissemination of real option applications and eventually lead to the use of more advanced real options tools, such as those already applied to real estate management and design by Greden and Glicksman (2005). The tool we develop describes heuristics for using a combination of backcasting and real options that should make real options more applicable in practice. Table I describes the various types of real options with examples of their application in construction projects based on Amram and Kulatilaka (1999), Fichman *et al.* (2005), Sommer and Loch (2004) and Winch (2010). Amram and Kulatilaka (1999) provide a taxonomy of real options within which we can place the abovementioned real options. The taxonomy consists of investment and disinvestment options, timing options, contractual options, and operating options. Investment and disinvestment options may significantly change the asset configuration by using scaling up, scaling down, and growth options. Timing options, such as to delay or to accelerate, also fall within investment and disinvestment options. Contractual options reflect contract terms that

Goal of real options (Amram and Kulatilaka, 1999)	Types of real options (Trigeorgis, 1993; Sommer and Loch, 2004; Fichman <i>et al.</i> , 2005)	Real options “in” and “on” the project (De Neufville <i>et al.</i> , 2008a)	Examples of applications in healthcare real estate construction projects
Waiting-to-invest option	Defer	“on” the project	If there is uncertainty on governmental regulation, the project might need deferral
Growth option of a market	Growth, switch function	“in” the project	Other demands can necessitate the switch function or expanding or shrinking the real estate
Flexibility options	Growth, scale up and down, switch function	“in” the project	When organizational demands change: expand the building, scale up or down, or use the switch function
Exit options	Abandon	“on” the project	When finance cannot be obtained, it should be possible to abandon the project
Learning options	Select	“on” the project	Select several architects to obtain knowledge on the best one
Irreversible investments	Stage	“on” the project	A construction project is irreversible. By staging the project, a go/no-go moment is provided after each stage

Table I. Types of real options and example applications in construction projects

change the risk profiles faced by asset owners: that is, the contingency adaptability in a project coalition (Luo, 2002). Since all types of options can be defined in contracts, they can all to an extent be seen as contractual options. Operating options relate to options linked to an asset in use, such as a switch option. A service can also be stopped (the option to abandon), or scaled up or down, and can grow or shrink. The aim of the tool is to identify several real options that can qualitatively be applied in an organization. Several pieces of research have already investigated the use of real options in real estate development, although this has often concerned only one or two types of real options. Nevertheless, these applications are a useful complement to the proposed tool, as an elaboration on how to proceed with quantifying these real options. Examples concern the real options to switch (Greden and Glicksman, 2005) and to grow (Guma *et al.*, 2009). De Neufville *et al.* (2008a) made a distinction between real options “in” and “on” the project. The former deals with technical solutions in the building whereas the latter points at flexibility in the process of developing the project. Referring to the former mentioned classification of flexibility, financial- and process flexibility are provided by real options “on” the project, while product flexibility is provided by real options “in” the product. Organizational flexibility might concern both types of real options.

4.2 Scenario planning methods

Scenario planning is a management tool, developed by the RAND corporation in the 1960s, used to develop strategies for uncertain futures (Schoemaker, 1993; Van der Heijden, 1996). Scenarios are plausible descriptions, not predictions, of the future that highlight critical sources of uncertainty that an organization should be aware of and adapt to through strategy development. A strategic decision is defined as “a decision that forces the organization to ponder its very existence, independence, mission, and main field of activity” (Lesourne, 1994; in Godet (2000)). Scenarios can be developed according to two schools of thought: the qualitative “intuitive logics” or the quantitative “probabilistic modified trends” (Bishop *et al.*, 2007). For several reasons we have opted for the first approach. First, because we distinguish between risks and uncertainties and, according to the definition of Knight (1921), uncertainties, unlike risks, cannot be predicted and therefore cannot be quantified. Here, the focus of our research is to improve the ability of health organizations to adapt to uncertainties since these are currently often excluded from strategies because they are difficult to assess. Second, because research has shown that descriptive scenario planning is the most useful approach in strategy formation for an organization (Schoemaker, 1993).

We follow the categorization of Börjeson *et al.* (2006) when describing the various scenario planning methods. This typology is divided into three categories of scenarios, each with two types:

- (1) predictive scenarios with forecasts and what-if types;
- (2) explorative scenarios with external and strategic types; and
- (3) normative with preserving and transforming types.

Since we explicitly do not set out to predict the future because of the unpredictability of the uncertainties influencing health, the predictive scenarios are not used in this study. The exploratory scenario category can answer the “what can happen?” question. These scenarios are more descriptive, and the aims can be to raise awareness, to stimulate creative thinking, or to gain insights into the ways societal processes influence one

another (Van Notten *et al.*, 2003). As already noted, two types of explorative scenarios exist: external scenarios and strategic scenarios (Börjeson *et al.*, 2006). External scenarios incorporate issues that are beyond the influence of the organization whereas strategic scenarios deal with the possible consequences of actions taken within the organization. Exploratory scenarios are mainly useful in terms of strategic issues: where the scenarios can help to develop robust strategies that resist the consequences of possible future situations (Van der Heijden, 1996). Since health organizations face many external uncertainties, external scenarios are especially useful. However, the question remains as to what these contextual scenarios specifically mean for the provision of healthcare, and accordingly for the layout of an organization's real estate. The third scenario type, normative scenarios, might be useful in describing how a certain future can be reached.

Normative scenario studies are useful in developing a strategy in which envisaged future targets can be met. Of the normative scenario options, transforming scenarios are more relevant than preserving scenarios here since the former aim to describe how a future situation can be reached when the current system is changing. We are currently witnessing changes in the healthcare system, and can expect more of such drastic changes in the future. One method for developing strategies to reach a future situation is known as backcasting. This is an approach that involves reasoning back from a desired image of a future situation to identify those changes that are required to create this image. The term was introduced by Robinson (1982, in Dreborg (1996)) who, in a later publication, defined backcasting as follows:

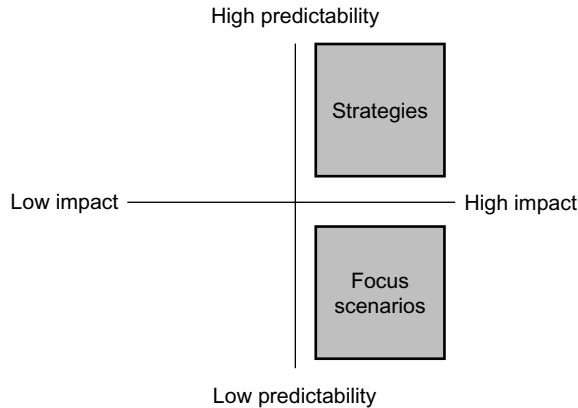
The major distinguishing characteristic of backcasting analysis is a concern, not with what futures are likely to happen, but with how desirable futures can be attained. It is thus explicitly normative, involving working backwards from a particular desirable future end-point to the present in order to determine the physical feasibility of that future and what policy measures would be required to reach that point (Robinson, 1990).

When applied to real estate, the question becomes what flexibility is needed to achieve potential future layouts given the current layout. Various methods have been proposed for backcasting (Börjeson *et al.*, 2006; Dreborg, 1996).

According to Van Notten *et al.* (2003), various scenario types can legitimately be used in a single study. Therefore, for the development of our decision support tool, we use external scenarios, to describe the possible future contexts in which health organizations will act, and transforming scenarios to develop a strategy to reach this future situation. Within the several scenario types, various techniques can be applied in the three phases of scenario development: generating, integrating, and consistency. The Delphi method is often used to collect views and ideas regarding elements of the future (Börjeson *et al.*, 2006), and we apply this to identify uncertainties with a low probability but a high impact. These are important in scenario planning since predictable uncertainties are often already incorporated in organizational strategies (Evers *et al.*, 2002). This distinction is shown in Figure 2.

5. Developing the decision support tool

Following the research framework shown in Figure 1, we combine the various concepts and methods from the knowledge base described in the previous section to develop a decision support tool. The purpose of the decision support tool is to gain insight into the flexibility needed in healthcare real estate in the form of real options. Knowledge on the

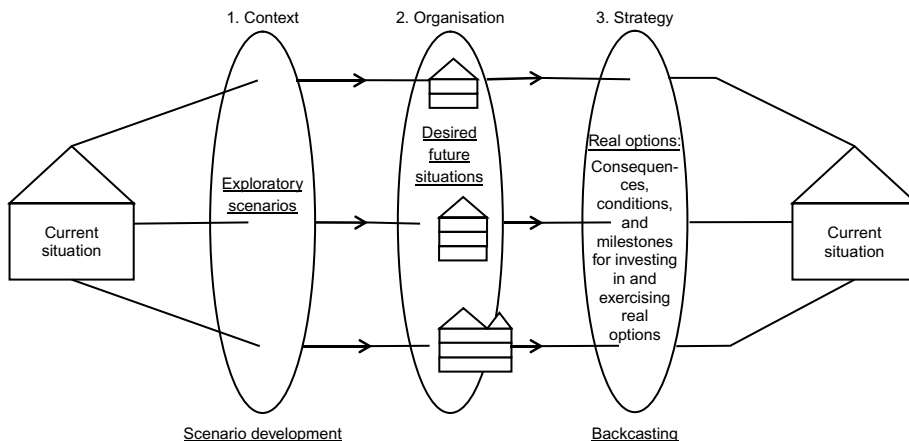


Source: Evers *et al.* (2002)

Figure 2. Mapping strategic choices

real options needed and their implications in terms of the interests of the organization and potential investment is useful when negotiating with contractors. The eventual tool is shown in Figure 3 and, in this section, we explain and test the various stages of the decision support tool by means of a workshop, interviews before and after the workshop and by observations during the workshops.

The first stage of the tool consists of discussing the contextual scenarios, which are developed in advance by means of interviews with experts. The subject of these interviews are developments influencing health organisations. By means of a Delphi survey consensus is created on the height of the impact and the degree of uncertainty of the various trends. In the second stage, the participants of the workshop define future situations of their organization and real estate within the contextual scenarios developed. Commonalities within these future situations have to be determined, which will be then the desired future situation. Within the third stage, the workshop participants develop



Source: Adapted from Kok *et al.* (2011)

Figure 3. Three stages of the decision support tool

a strategy including flexibility in terms of real options, in order to reach this desired future situation. Before and after the workshop the participants are interviewed to test their knowledge on the real option concept, and to check their opinion on the usefulness of the workshop. We also ask for recommendations to improve the workshop.

The tool was tested by means of a workshop, interviews before and after the workshop and by observations during the workshop in a Dutch hospital. This test resulted in several design propositions to improve the tool. The workshop included nine people, of which five were employees from the hospital involved in the new construction project or maintenance of real estate. They represented various interests in the organization since they fulfilled the following functions: construction coordinator, technical service employee, healthmanager, member of patient council and head finances. The current hospital was built in 1975 and during the course of time extended. It was a regional hospital with loyal patients who choose not to go to larger hospitals in the surrounding larger cities. However, the management fears that this situation will not hold much longer, also because these larger cities are constructing new and appealing hospitals and the current hospital is obsolete and inefficient. The initiative for the new hospital already dates from 2007, but because of problems with financing the project, construction has still not started. In the same time, various new developments forced the hospital organization to rethink the design of the new hospital. During the time that the research took place, the project was still postponed since all strategies to obtain financing failed.

5.1 Stage 1: discussing exploratory scenarios

Broadly speaking, three steps can be identified in developing scenarios: first – identify major concerns about future developments; second – focus on the discussion of key uncertainties and driving forces; and third – develop the actual scenarios (Kok *et al.*, 2006).

In the first step, we interviewed key people in healthcare and in real estate management of participating organizations. According to Slocum (2003), the scenario team should comprise decision-makers (whose mandate or competence is relevant to the focal issue or question), and also cover a broad range of functions, areas of expertise (political) perspectives, and creative thinking. In this case board members and project managers of the hospital and an elderly care organization, and a researcher from a research institute were interviewed. We asked these respondents to give their opinions on the predictability and impact of uncertainties which are “general environmental” and include the following areas (Miller, 1992); political, governmental policy, macroeconomic and socio-economic/demographic. The health sector is another source of uncertainty, for example because of the upcoming of new technologies, medicines and treatments. We also asked for trends within the organization, which might have a large influence on the organization. By means of a Delphi survey using an online survey tool, a ranking of most influential and unpredictable developments had been identified and used to develop scenarios to be presented and discussed in the workshop (Table II). More predictable trends such as demography were incorporated as well since these have a high impact and make the scenarios more plausible. Two extreme, but plausible, scenarios plus one trend scenario in which the future health organization might operate were developed.

These scenarios were contextual scenarios of environments: short descriptions of future external developments, with differing economic situations being the most distinguishing factor. The scenarios were further bounded by the lifetime of the building, which is set at around 30 years. The economic situation as the overarching

Trend scenario Remaining average recession in The Netherlands	Scenario A Economic bloom, European integration	Scenario B Economic recession, European segregation
Increasing healthcare costs Ageing of population, diseases of civilization	Health costs increase in Europe Large demand for Dutch health care from the whole of Europe	Large income differences in and between regions Braindrain of doctors and personnel, healthcare worsens, competition of other countries
Gradual introduction of marketization. No focus on prevention More competition and patient oriented Innovation in construction industry. Bad market for offices Lack of personnel	European health system. More cross-border healthcare. More marketization. Less prevention Importance of patient orientation Advanced construction and medical technologies. Focus on life cycle costing More efficiency: less personnel needed because of technology	Health is stripped off. More government control on healthcare provision. Focus on prevention Low efficiency: low level of cooperation of healthcare providers Low construction costs, high maintenance costs. Low level of innovation Difficult to obtain loans from banks
More attention to life cycle costs	Scaling down is trend, locations in living areas, healthcare home delivery	Clustering of functions on outskirts of the town
More outsourcing of service tasks	Pill against dementia	Less diseases of civilization because of "crisis menu" (people have less money for unhealthy food)

Table II.
Main trends in each
scenario

theme of the scenarios since it has a very large impact, including on the other driving forces within the scenarios. For example, the ability to obtain loans from banks is heavily governed by the economic situation. The European situation is seen as the other key dimension and represents both demographic and institutional developments. In choosing these two main dimensions, a balance is struck between overly complicated scenarios and capturing the complexity of today's problems (Grossmann, 2007). These two dimensions are used as a "backbone for scenario development", i.e. they form a framework within which various scenarios can be developed (Van't Klooster and van Asselt, 2006). The scenarios were presented, discussed, and refined in a workshop.

The aim of the tool is that it will be institutionalized in the organization and that health organization employees, as described in Van der Heijden (1996), will be able to make such scenarios themselves in the future since, by their very nature, uncertainties change.

5.2 Stage 2: visualizing future situations within the contextual scenarios

Since health organizations adapt their primary process to various developments, and real estate needs change within this process, different facilities are required under different scenarios. In our approach, participants in the workshop were asked to define desirable real estate futures given the different contextual scenarios. A floor plan of existing functionalities was used to visualize the current situation and facilitate thinking on the future situation (Figure 4). The areas (in square meters) given over to various functionalities were also provided. The workshop participants were asked to think about the influence of the possible scenarios on the types of functions and floor

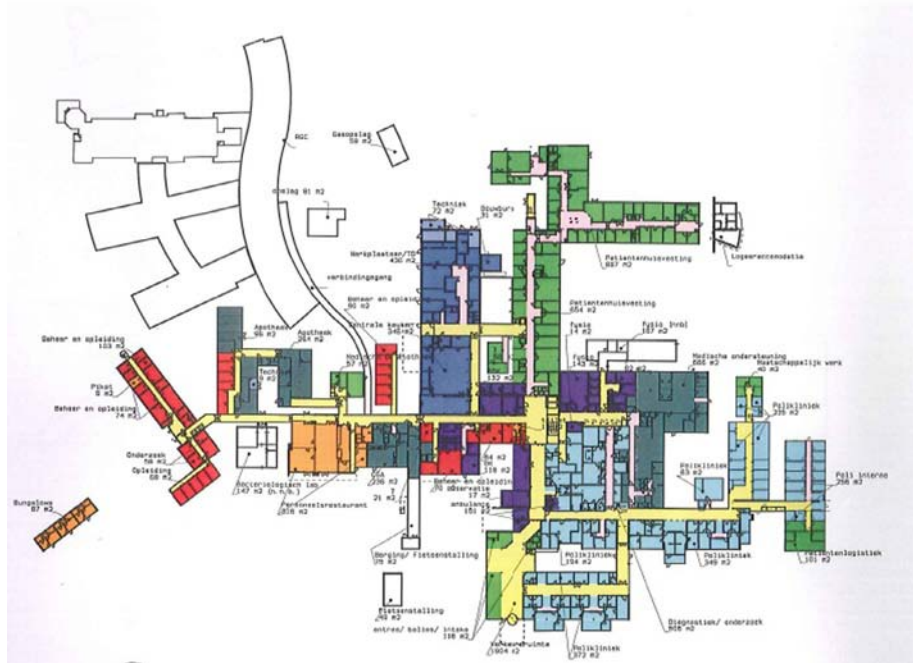


Figure 4.
Floor plan of first floor
of the Mountain hospital

areas needed in the future. Various scenarios resulted in different views on the future real estate. The aim of the workshop was that the participants would find commonalities between these future pictures and in that way define a future situation of their real estate that is an adaptation to the various plausible scenarios. This future picture is not only dependent on various types of healthcare that will be provided in the hospital and thus the primary process, but also on other interests in the organization and the importance which is assigned to these various interests., For example, if healthcare expenses increase and in the same time less means are available to provide healthcare, there will be more focus on cost reduction than on patient orientation, resulting in a less luxury and spacious hospital.

5.3 Stage 3: real options applicable to reach future situations

Using backcasting, and reasoning backwards from the desired future situations, the mismatches with the current situation could be identified along with the types of flexibility needed. For example, if the participants expect more space to be needed for certain functions then technical flexibility to expand the building is required. Similarly, if functions change within the building, the technical infrastructure should also change. This requires both technical flexibility to adapt and also process flexibility over the maintenance of the building. If maintenance is outsourced, then a the contract with that external party should include a term that enables the adaptation of the building. In applying the backcasting approach, the third stage enables a better determination of which real options are applicable for reaching future situations within the contextual scenarios envisaged. The third stage involves the following steps:

- (1) Define the difference between the ideal future picture and the current situation.
- (2) Determine which types of real options are necessary to enable the required flexibility. Here, the concept of real options is discussed in advance of the workshop and a list of real options and their potential consequences are provided.
- (3) Assess which quality dimensions are most important in each phase of the project:
 - impact; the influence of the build to forms and materials, internal environment and identity and character;
 - build quality; the quality of the construction and its performance; and
 - function; implying factors such as use, access and space (Gann *et al.*, 2003).

Determine those real options required to achieve the most important dimensions of quality. By ranking the importance of each dimension in a certain project, the client is better able to determine which real option is most suitable, or should be prioritized when it comes to investment:

- (4) Define conditions that are necessary to enable investing and exercising real options. Can milestones be recognized among these conditions?
- (5) Identify the real options and milestones that are required in the strategies of all the potential scenarios. These constitute robust real options and milestones, and together should constitute the real estate strategy.
- (6) Compare the consequences of the chosen real options for all the stakeholders under all the various scenarios. Choose the real options with the highest value, i.e. the most benefits for all stakeholders and the fewest negative consequences.

Based on these steps, real options are identified and presented using the format of Johnson *et al.* (2006) and Ford and Garvin (2009). An example of a real option identified in the workshop of the first test of the tool is shown in Table III.

6. Discussion and conclusion

Following the research framework shown in Figure 1, a decision support tool has been developed for identifying the flexibility needed in a project so that it can adapt to future uncertainties. In this final section, we will briefly reflect on the workshop in which we tested the tool and present various design propositions for each stage which we derived from experiences in the workshop and the suggestions done in the interviews.

Main uncertainty	Additional specialisms want to take seat in the hospital, or extra patients come to the hospital
Potential strategies	Investing in an extra strong foundation for eventually an extra floor, or doing nothing
Consequences	If the demand increases or space for an additional specialism is required, then an additional investment should be done to build an extra floor. If there had not been built an extra strong foundation, then the hospital should be extended elsewhere, with consequences of inefficiency as in the old hospital. What is it worth to invest in an extra strong foundation? What are possible costs and benefits?

Table III.
Presentation of a concrete example of a real option in the workshop

We developed the scenarios quite elaborately. However, since health organizations often have a lack of time and money to do this exercise extensively by themselves, we would like to propose a more simpler approach:

- P1.* When there is lack of time to develop scenarios more simpler scenario types with only two driving forces on two axes is an effective starting point for discussion on consequences for real estate.

In the second stage, there was a rich discussion on the future of the hospital but this was less reflected in a concrete picture of a hospital in the future which made it more difficult to do the backcasting exercise. One participant mentioned that a better preparation by the participants would generate more discussion since people could have thought of it beforehand. To improve consecutive workshops we propose the following:

- P2.* In order to stimulate the participants to think of a future situation of the real estate, an overview with floor areas has to be provided in advance with a clear assignment, in order to provide participants time to prepare and generate more input in the workshop.

According to the participants, concrete examples of real options were very useful to get an idea on how to apply the approach and to generate new ideas. In addition, participants in the test workshop thought that it was easier to think of costs and benefits of real options “in” the project than real options “over” the project. However, the idea to weigh strategies with and without a certain real option in order to see whether investing in flexibility and to which amount, was thought to be useful by most participants. This resulted in the following proposition:

- P3.* When there is no or little knowledge on the concept of real options, concrete examples of real options should be handed out in advance of the workshop in order to provide participants to generate a more equal knowledge base among the participants and generate more input in the workshop.

Various project-specific conditions determine which real options can be used. The aim of the real option analysis and backcasting approach is merely to create a useful way of thinking. When the approaches are internalized in the mindset of people, then ideas can arise outside of official meetings (Godet, 2000). This is termed “second loop learning” by Argyris and Schön (1996).

Since most interests of corporate real estate management were represented in the workshop, the workshop in itself created more mutual understanding. It appeared that brainstorming about real options was beneficial for an improved design of the hospital. Therefore, such a workshop is especially useful in the initiation and design phase of a construction project.

In addition, developing a similar decision support tool for contractors, or encouraging the participation of contractors within a workshop for a health organization, could be beneficial. The latter would create mutual understanding and trust between clients and contractors, and improve their cooperation, an idea proposed by several authors who recognize trust as an important factor in project success (Laan, 2008; Ring and Van de Ven, 1992). Further, based on their specific knowledge, contractors could then make useful inputs in an early stage by highlighting the limitations and opportunities

of certain real options. The proposed approach could also be applied in real estate projects in sectors other than healthcare.

In this research, we have developed and tested a decision support tool by applying a design science research method based on the framework of Hevner *et al.* (2004). In this way, rigor has been ensured in the research. Relevance is claimed since the tool supports healthcare real estate managers in defining required flexibility. The design propositions derived in this research should be tested in other workshops for further improvement. By applying the tool, health organizations can increase the professionalization of their real estate management and improve the match between current and future real estate demand and supply, so adding to the effectiveness and efficiency of healthcare in general.

Note

1. The *Bouwcollege* (Netherlands Board for Healthcare Institutions) was a governmental institute established to effect the law related to healthcare provision. Prior to its demise in 2010, its tasks included determining performance indicators for building construction in healthcare, providing permits with relevant conditions for construction projects, and advising the Ministry and health organizations. Prior to any permit being given, the Ministry had to agree that the building construction was necessary.

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