This paper is the first to introduce critical systems thinking into a new emerging research strand: the design of organizational space. The study revealed two things. First, critical systems thinking provides a thorough framework to understand the possibilities to connect organization and building; both in a conceptual understanding of the mutual relations and with regard to the practical implications that such connections have. Second, an application of critical systems thinking in an immersive virtual environment resulted in an inspiring debate around all sorts of facts and values of the current and expected future states of organizational space. It raised the awareness about a true interdisciplinary design in organization and architecture and allowed significant improvements to be made. This paper may be also regarded as an introduction to an application of critical systems thinking in other design processes where human and technical systems designs are interwoven. Copyright © 2007 John Wiley & Sons, Ltd.

Keywords  architecture; critical systems thinking; health care; organization; virtual reality

INTRODUCTION

Organizations do not only use their building to sit dry and comfortable, but in many cases they actively seek to structure the work, improve the performance, and express their corporate identity through architectural design. The building appears to exceed the meaning of its combined materials. It seems that organization and architecture have a lot in common. It is pre-supposed here that a construction or re-construction is a wonderful opportunity for any organization. It can support organizational design or change, or improve current organizational processes and outcome. We may expect the leaders of organizations to impose their strategic vision on the architectural design of a building and use it to restructure the work when necessary. However, in contrast O’Mara (1999a) has argued that organizations hate to make decisions about real estate and facilities, which indicates that substantial progress can be made in this area.

In this paper, modern systems thinking is used as a perspective on the interdisciplinary design of organization and building: a design of organizational space. It mainly served as an ingrained way of perceiving the relation between organization and architecture, rather than as a strict use
following the prescribed guidelines of systems scientists. However, the paper must not be regarded as a systems thinking ‘light version’, it is not by any means purely pragmatist in its orientation. It seeks to find relevant applications of the basic ideas of critical system thinking (CST) and the methodologies and methods incorporated within it that allow advancements on the interdisciplinary design of organizational space. CST was mainly used in three ways: as a structure for the manuscript, as an organizing tool for the enormous quantities of data and as a fundamental framework for a debate in an immersive virtual environment. This paper is the first to introduce CST in this area. With its methodological pluralism and engagement with emancipation, CST does provide manager and architect with rigorous support. It enables researchers and practitioners to view the design of organizational space as a holistic system, critically reflect upon broad participation and find accommodations for design solutions with the spirit of pluralism. In short, CST does offer a valuable framework, not only to secure significant improvement in a problem situation in practice, but also allowing to structure large quantities of data and to foster the making of new combinations with the latest developments in high-tech simulation environments.

DESIGN OF THE STUDY

The main aim of this current study is to define an organization in its relation with architecture by using modern systems science. It contends with some of the issues currently known in the management and organization sciences, and describes studies performed in health care design practices. The study is designed according to the three-phase approach of CST (Jackson, 2000, 2003): creativity, choice and implementation. A summary of this three-phase meta methodology, originally based upon ideas and frameworks defined in a system of systems methodologies (Jackson and Keys, 1984) and total systems intervention (Flood and Jackson 1991a, 1991b), is shown in Table 1. In the creativity phase, significant concerns, issues and problems related to organizational and architectural design were identified. In the choice phase, an appropriate systems intervention methodology was chosen. In the implementation phase, system methodologies were employed in different health care design practices.

The first phase: creativity was theoretical research. It aims to select ideas from modern systems science which may be supportive to connect organizational with architectural design. This first phase comprises two layers. The first layer deals with the meeting of organizational and architectural design. It is a general description of the kinds of issues and problems that matter in this special context. The second layer deals with the possibilities to use modern systems science in the interdisciplinary design of organizational space.

The second phase: choice was theoretical positioning in terms of meta-methodology, methodology and method. This second phase also comprises two layers. The first layer deals with the arguments to use CST and some of the

| Table 1. The three-phase meta-methodology of critical system thinking |
|-------------------------|-----------------|------------------------------------------------|
| Task                    | Tools            | Outcome                                      |
| Creativity              | Highlight concerns, issues and problems | Use creativity-enhancing devices | Identify dominant and dependent concerns, issues and problems |
| Choice                  | Choose appropriate systems methodology or methodologies | Use meta-methodology to reveal strengths and weaknesses | Choose dominant and dependent methodologies |
| Implementation          | Arrive at and implement positive change proposals | Employ chosen methodologies with an open mind for other potentially relevant ones | Change to improve the problem situation |

Adapted from Jackson (2003).
methodologies and methods within it. Even though in some cases, the methodological rules were followed strictly, this current approach must be regarded as a systems perspective: mainly an organizing principle of the research. For instance, to determine if and how the interpretative perspectives may be connected with the functionalist perspectives, to what extent the connection between interpretative and functionalist perspectives were actually observed, to use interpretative, functionalist, emancipatory and postmodern perspectives in empirical studies at a design process, and finally to explore possibilities to connect them. The second layer deals with the according methods chosen. For each critical systems perspective, different kinds of data-collection methods were used.

The third phase: implementation was empirical research. It aims to use the selected systems perspectives, combine them, discover its functionality in practice and learn from it. This third phase comprises desk research and field research. The desk research was made at health care premises for children. The field research was made at the design processes of a community hospital and a community-based pharmacy. The combination of all perspectives included in CST was explored in an immersive virtual environment for the design of the pharmacy.

From above, we can learn that this study seeks to explore and improve the coherence between organizational and architectural design, drawing from the basic ideas of Jackson’s CST. This idea underlies all phases.

CREATIVITY

Organizational and Architectural Design

Although the connection between organizational and architectural design is special, it is not new. One of the early well-documented combinations of organization and architecture is in the Panopticon writings of Jeremy Bentham (Božović, 1995). In his work, the organizational design of a penitentiary was explicitly linked to the architectural design. The organizational essence in the design was the invisible omnipresence of the inspector, power through the principle of ‘seeing without being seen’, in combination with the circular form of the building. It was expected that if prisoners felt that they were observed all day, there was literally no space for bad behaviour, which would automatically transform them into good people. Moreover, the ideas of Bentham were based on the concept of deterrence: the prison as a theatre to prevent innocent becoming offenders. A scream every now and then from the building, heard by passers-by, would support that idea, even if it was done by actors (Božović, 1995). Consequently, the Panopticon was planned to be a circular building with an inspector’s lodge at the centre and prisoner cells in the circumference. The cells had a window for lighting, during the night secured by small lamps outside the window, and light iron grating; all allowing the inspector to view every single movement of the prisoner. Although the Panopticon was never built, the ideas of Bentham have been very influential in modern thought on punishment and power (Harrison, 1985).

Other more recent studies also concentrate on an empirical domain or seek to advance the theoretical development in a specific area. Interesting examples of empirical studies can for instance be found in the design and organization of a health care premise (e.g. Crisp, 1999; Hamilton, 2003; Huelat, 2003; Ulrich et al., 2004), a library (e.g. Shaw, 1955; Brawne, 1970; Renes, 1983), a museum (e.g. Yamaguchi, 1989; Karp and Levine, 1991; Véron and Levasseur, 1991; Yanow, 1998), an office (e.g. Davis, 1984; Marmot and Eley, 2000; Henderson and Mays, 2003; Myerson and Ross, 2003; Becker, 2004), a prison (e.g. di Gennaro, 1975; Besier, 1979; Crisp, 1999; Fairweather and McConville, 2000), a service organization (e.g. Bitner, 1992; Sherry, 1998; Aubert-Gamat and Cova, 1999) and a shopping environment (e.g. Darden and Dorsch, 1990; Turley and Milliman, 2000; Chung and Cha, 2001; Lam, 2001). Examples of theoretical studies can be found in organizational behaviour (e.g. Steele, 1973; Steele and Jenks, 1977; Becker, 1981; Milliman, 1986; Sundstrom and Sundstrom, 1986; Broadbent, 1988; Sundstrom and Altman, 1989;
Mobach and Rogier, 1995), marketing (e.g. Kotler, 1973; Donavan and Rossiter, 1982; Milliman, 1982; Titus and Everitt, 1995), strategy (e.g. Nourse and Roulac, 1993; Roulac, 1995; O’Mara, 1999a, 1999b), culture (e.g. Broadbent et al., 1980; Rapoport, 1982; Gagliardi, 1990; Yanow, 1993; Becker and Steele, 1995; Hillier and Hanson, 2001) and technology (e.g. Hiscox and Stirling, 1939; Ireson, 1952; Frampton, 1980; Rigot-Müller, 2004).

Although the profundity and quantity of the performed studies from above is respectable, the leading authors in the mainstream of organization science have elaborated the issue poorly, if not ignored it completely (see for instance: Clegg et al., 1997; Daft, 2004). The same goes for systems science (see for instance: Midgley, 2003), the connection between organization and architecture is not a mainstream issue and only rare exceptions seem to prove the rule (e.g. Handler, 1970; Broadbent, 1988). Even though very recent developments in organization science seem to suggest that the issue is being taken up more seriously (see for instance: Kornberger and Clegg, 2004; Burrell and Dale, 2007; Clegg and Kornberger, 2006), a modern approach encompassing the youngest systems ideas to serve practitioners working in this area remains absent until today. That is surprising because a systems perspective can be so relevant in this area. After all, one of the key qualities of systems science is that it functions extremely well in an interdisciplinary context where other approaches may not always be successful. This paper seeks to reduce that gap by an application of modern systems science in the design of organizational space in health care.

European studies indicate that substantial progress can be made in the area of designing organizational spaces. The convergence of organization and building is far from ideal. Although exact data on the cost of reconstruction directly after completion of the building are not yet available, studies initiated by the Dutch government buildings agency estimate that the cost for a follow-up, absorbs 5% of the total budget for buildings in their portfolio (Damen Consultants, 2000; Schop, 2001). Although these data are rough estimations, for organizations we may expect substantial benefit from improvements in the design process. Even regarding the relatively small Dutch total production volume for organizational space at the public and the private sector €1.52 and €6.34 billion, respectively, in 2000 (Statistics Netherlands, 2001), the problems have considerable financial substance. On a European or worldwide level, the financial benefits for organizations can be enormous.

From a scientific point of view, there are also many contributions to make, for instance: In what ways can spatial data be analysed? How does change in the physical arrangements affect the organization? When does the building stimulate or hinder the organization? How are organizational concepts expressed in physical arrangements? How can we boost processes of creativity and innovation in the design process? Be reminded that this paper seeks to find systems approaches to management, in this case drawn from CST, relevant for managers facing construction or reconstruction of their premises. It seeks to develop managerial support by using a systems perspective: how can CST support the manager with her work in this special context? Before we address this issue, CST is explained briefly.

Critical Systems Thinking

In the last 15 years, there has been a significant rise of successful meta-methodologies connecting different systems approaches (e.g. Flood and Jackson, 1991a, 1991b; van Gigch, 1991; Daellenbach, 1994; Flood and Romm, 1996; Mingers and Gill, 1997; Jackson, 2000, 2003). The most important approaches are the critical systems approach and the multi-methodological approach, which both can be seen as particular forms of methodological pluralism. In the critical systems approach, the embedded systems approaches remain intact and in the multi-methodological approach, the combination of more than one methodology is either in whole or part depending on the specific problem situation. Currently, CST identifies four major strands: functionalist, interpretive, emancipatory and postmodern approaches. Each of them includes
various methodologies, methods and techniques to understand and tackle different complex problems. The four approaches will be explained briefly. For a more extended overview, I refer to Jackson (2000, 2003).

**Functionalist Approaches**

The functionalist systems approaches concentrate on objectivity. From the management perspective, these approaches aim to gain control over a situation and use expert knowledge to achieve that goal. It is held that the relation between cause and effect can be visualized, since constraints are firm and goals are unambiguous (Rosenhead, 1989). A problem is ‘out there’ and can be solved in one best way, mostly resulting in a mathematically sophisticated solution. Such as the calculation of the efficiency or the profitability of a manufacturing process in organizations, can the strength of materials in architecture or the translation of a complicated architectural form into manufacturing data be calculated and incorporated in the best design solution within defined constraints. As such is the functionalist perspective, an indispensable constituent in any design process. Examples introduced by Jackson (2000) are the functionalist systems approach (Churchman et al., 1957), sociotechnical systems approaches (Trist and Bamforth, 1951), systems dynamics (Forrester, 1969), cybernetics (Beer, 1979), autopoiesis (Maturana and Varela, 1992) and complexity theory (Stacey, 1996).

**Interpretive Approaches**

The interpretative systems approaches are used in areas where differences in opinion are common, as well as try to find common ground in these potentially discordant situations. Vital is that these approaches allow different worldviews on the same events (Wilson, 1984, 2001), evidently leading to the disclosure of different opinions. These approaches do not aim to be objective, but aim to master the variety and learn from it. They help to improve the understanding of complex situations and to organize a debate, for example, about corporate strategy, identity and change, and the way in which these issues can be consistently expressed in an architectural concept and the interior and exterior of the building. The interpretative perspective may be regarded as an opportunity to prepare the organization for its meeting with the architect. Some of the most common approaches mentioned by Jackson (2000) are the fifth discipline (Senge, 1990), interactive management (Warfield, 1994), interactive planning (Ackoff, 1999), social systems design (Churchman, 1979), soft systems methodology (Checkland and Scholes, 1990), strategic assumption surfacing and testing (Mason and Mitroff, 1981) and strategic options development and analysis (Eden and Ackermann, 1998).

**Emancipatory Approaches**

The emancipatory systems approaches concentrate on broad participation. Mostly, it aims to improve the position of the less powerful in the decision-making process. It has a special focus on the ones not involved but affected, and seeks to unmask domination. To an extreme, this sheds light on the relation between Robert Mugabe and the affected inhabitants of the slum housing. The houses that were demolished in Operation ‘Murambatsvina’ (Drive out the rubbish) left more than 700,000 people without homes or businesses in Harare in Zimbabwe in the summer of 2005. But also less poignant examples, like the absence of the direct involvement of customers in the design of new offices, hospitals or stores (Mobach and Rogier, 1997; Mobach, 2006) show that broad involvement of the ones affected is not always very common. Examples given by Jackson (2000) are critical systems heuristics (Ulrich, 1983) and team syntegrity (Beer, 1995).

**Postmodern Approaches**

The postmodern systems approaches stimulate diversity and creativity. They aim to make practical progress in a complex world through
the cultivation of conflict and activities to endure enthusiasm. No orchestration of multiformity and holism, but an embracing of it, boosted by spontaneity, creativity, joy and playfulness. The objective truth is replaced with feeling and fun. It goes without saying that creativity is an indispensable constituent to create new buildings. It is also quite clear that any design process draws heavily on the creative resources of its participants. Because design processes take their time, it may be hard to keep the positive spirit alive. The stamina of its participants is pushed to its limits. These approaches aim to be lively and refreshing. They replace boring technical requirements lists and morphological cards with questions such as: How does this feel? Is this fun to do? Is this the best option, at least for the moment? And stimulate participants to work with hyper-realistic simulations. Jackson (2000) gives participatory appraisal of needs and the development of action (Taket and White, 2000) as an example of this approach.

Using and Combining Four Approaches

For the use and combination of the approaches, Jackson advises us to use the grid: a system of systems methodologies (Jackson and Keys, 1984). The horizontal axis distinguishes unitary, pluralist and coercive relationships between the participants concerned with the problem context. Unitary relationships means that participants have similar values, beliefs and interests. Pluralist relationships means that although the basic interests of the participants are compatible, they do not share the same values and beliefs. Coercive relationships means participants have few interests in common and, if free to express them, would hold conflicting values and beliefs. The vertical axis comprises simple and complex systems. Simple systems are relatively stable: they have little variety in the properties of the elements and relationships, do not change much over time, have structured interactions and a small number of sub-systems resulting in a limited layered structure. In contrast, complex systems are systems ‘on the move’: they have a large variety in the properties of elements and relationships, are subject to vast change, have loosely structured interactions with an unprede-termined outcome and a large number of sub-systems resulting in an extended layered structure. Jackson (2003) advises us to use hard, soft and emancipatory systems approaches if the systems of the problem situation are simple, and to use systems dynamics, organizational cybernetics, complexity theory and soft systems and postmodern systems approaches if the systems of the problem situation tend to be complex (Table 2). Moreover, we should employ functionalist systems approaches in problem situations where unitary relationships can be expected, interpretive systems approaches where pluralist relationships can occur and emancipatory and postmodern systems approaches for dealing with coercive relationships between participants. In summary, we are advised to follow the three-phase approach of creativity, choice and implementation in combination with the grid for making combinations between systems approaches. This approach should

<table>
<thead>
<tr>
<th>Participants</th>
<th>Systems</th>
<th>Unitary</th>
<th>Pluralist</th>
<th>Coercive</th>
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<td></td>
<td>Simple</td>
<td>Hard system thinking</td>
<td>Soft systems approaches</td>
<td>Emancipatory systems approaches</td>
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<td>Complex</td>
<td>Systems dynamics, organization cybernetics, complexity theory</td>
<td>Postmodern systems approaches</td>
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Adapted from Jackson (2003).
reveal the strengths and weaknesses of different systems methodologies and allow us to choose the right ones.

**CHOICE**

**Systems as a Perspective**

It goes without saying that systems approaches can be used in various manners. The research strategy followed here was that we applied systems theory mainly as an organizing principle for the data set and, in addition, in some situations as a set of guidelines to collect data. In this respect, the work of Quinn, Mintzberg and Waters (1988) is interesting as they have introduced the five Ps for strategy, which may also be useful to explain the research strategy followed in this paper. They coin strategies as plan, ploy, pattern, position and perspective. Strategy as a plan refers to some sort of consciously intended course of action, a guideline or set of guidelines to deal with the situation. Strategy can also be a ploy, just a specific ‘manoeuvre’ in response to some kind of threat, for instance of a competitor or opponent. Strategy as a pattern refers to consistency in behaviour: a pattern in a stream of actions. Strategy as a position is locating the organization in an environment and their final definition of strategy is a perspective: an ingrained way of perceiving the world.

This current research strategy was labelled as a perspective and as a plan. Although strategies as ploy, pattern and position do also have strong relations with basic issues treated in systems science, such as adaptation, system and open system, respectively, they were not found useful as an organizing principle for this research. The first research strategy, systems thinking as a perspective, may be regarded as an abstraction which exists only in the minds of interested parties. In this case, mainly the researchers. It is a figment in a researcher’s imagination and infers patterns from behaviour that has already occurred. An ex post organizing principle as it were. In this paper, CST was used to do so and to enhance the path finding through complex design situations and large quantities of data.

This meant that Jackson’s distinction between functionalist, interpretive, emancipatory and postmodern systems approaches to management and his basic principle of pluralism were used to organize the data. By doing so, it served as a multiperspective on the data. The second research strategy, systems thinking as a plan, may be regarded as a strict use of systems approaches, following the prescribed guidelines of the authors. The essential characteristic of this strategy is that its use is decided upon in advance and that they are made consciously and purposefully. For instance, in this paper, interactive planning was used to define a corporate strategy at the pharmacy which served as an ex ante data collecting principle. Three of Ackoff’s (1999) five phases were followed: formulating the mess, planning the ends with current and ideal states to enlighten the gap to be bridged and finally, planning the means to do so. Moreover, CST was used as a fundamental framework for an interdisciplinary debate about the design of a new building in an immersive virtual environment.

**Choice of Meta-Methodology**

CST was chosen because methodological pluralism was expected to be an important key to our understanding of the design of organizational spaces. A fundamental commitment to one perspective always has its limits; there is indeed a lot to learn from a combination of different perspectives. For our purpose here, methodological pluralism is of relevance, as we need to gain insight in an interdisciplinary area where issues such as performance (does it improve?), strategy (where do we go?), stakeholder participation (who is involved?) and emotion (is it beautiful and functional?) were discussed. CST was not regarded to be better or worse than the other meta-methodological frameworks per se, but it does provide researchers with a thorough description of the systems approaches to management, a well-established overview allowing a deep and credible understanding of the differences and connections and a structure to combine them. The relevance of methodological
pluralism for organizational space can be illustrated with the design of the architect Frank Gehry of the Guggenheim museum in Bilbao, the capital city of the Basque country. The design of the museum is a masterpiece of functionalist mathematical calculation through its combined material of glass, orthogonal limestone blocks and curved and bent titanium panels. At the same time, from other perspectives like the interpretive, emancipatory and postmodern ones, these calculations were the result of the people process between Thomas Krens (director of the New York Guggenheim museum and explorer of venues beyond its main building in New York), Frank Gehry, the Guggenheim foundation, the Basques authorities and local companies. In this part of the design process, the exploration of latent possibilities, interests and enthusiasm were finally elaborated in hard materials design. Interests such as the creation of an institute contributing to the identity of the Guggenheim foundation, of a building to exhibit art and of an intervention to master the violent image of the Basque country and transform its capital into an international centre for culture, finance and tourism. Moreover, especially local companies were involved in the constructions which were proud to give their utmost in creating a museum with global pretensions. The relevance of methodological pluralism can also be illustrated with an application of Jackson’s four perspectives in an example of the Olympic Games. A functionalist perspective like the recording of times for the 100-m freestyle swimming is necessary to select a new Olympic champion. An interpretive perspective may be more useful to select a new winner for the synchronized swimming. Although jury reports have robust criteria, differences of opinion will remain. The emancipatory perspective was rather alive in an extraordinary men’s horizontal bars final at the Olympics of 2004. Crowd displeasure forced judges to upgrade the marks of Russian gymnast Alexei Nemov. The crowd, standing clapping and boothing, upped Nemov’s mark with 0.037 to a 9.762 (although it did not help him to win a medal). Finally, most Games end budget neutral to the best or in a financial disaster to the worst. In 2006, the city of Montreal will pay off the last dollar of their 1 billion debts of the 1976 Games. From this perspective, it is astonishing to see administrators compete in the hope to host the Olympic Games. However, a postmodern perspective explains that it is not surprising at all: it is not a mere financial issue. Olympics is all about emotion. It promotes feelings of national pride, unity, fun and prestige.

These two examples show that life unfolds itself better to researchers which apply a pluralistic perspective. We gain a richer understanding of the world around us. It may avoid the ‘Honda-effect’: where a single perspective, in this case, a strategic one on the successful market entry of Honda in the U.S. by the Boston Consulting Group in the 70s, proved to be wrong (Pascale, 1984). Pascale has argued that a multiple perspective disciplines researchers against the cognitive and perceptual biases that produce this effect. Attention to multiple perspectives also causes researchers to grapple with the interdependencies of each, that none of the factors stands alone. Only when we move on multiple fronts, we achieve deep and credible understanding of the real world. In this context, the critical systems perspective is a good choice. It is expected to be extremely helpful in dealing with the variety of problems that arise from researching organizational and architectural design.

Choice of Methodologies

Following the work of Jackson (2003), all four methodological perspectives were found to be relevant. They were used separately and finally converged in the immersive virtual environment. Be reminded that if we would use Jackson’s work strictly, the three-phase approach of creativity, choice and implementation should be applied in combination with the grid for making combinations between systems approaches. Although we were strict in following the basic principles in this study, we deviated from this advice, because we used systems as a perspective. The pluralism

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of CST was used to organize the data; it served as a multiperspective on the different data. Roughly, we have used the functionalist perspective for hard data collection of the ‘ist’ (e.g. lead times, work flow, interior details), the interpretive perspective for soft data collection of the ‘soll’ (e.g. corporate strategy, corporate identity, atmosphere, aura, architectural concept), the emancipatory perspective for hard data collection of the ‘ist’ about the ones not involved in the decision-making process (e.g. staff satisfaction, customer satisfaction, customer behaviour), the postmodern perspective for hyperrealistic simulation (e.g. photographic material of the old building, staff and customer behaviour, 3D model of the new building and human behaviour within it) and the critical systems perspective for combining all the facts and values from all previous perspectives in an immersive virtual theatre.

Choice of Methods

Four different case studies at health care premises were made in The Netherlands. The studies were made at a Paediatric Department of an academic hospital, a holiday residence for children with life-threatening diseases, a community hospital and a community-based pharmacy.

The case studies at the Paediatric Department and the holiday residence were made with desk research. These studies may be regarded as a first exploration to assess if and how the interpretative perspectives can be connected with the functionalist ones.

The case study at the community hospital was a single case study concerning a new construction and partial renovation. During the 6 years, the design process was studied in a longitudinal comparative case study in The Netherlands. The study was made at a steering group consisting of: general director, medical director, director facility management, assistant facility management, three medical specialists (surgeon, internist and neurologist), manager outpatient’s clinic, architect and two architectural consultants. Depending on the issues on the agenda, the group was extended with an interior architect, installation-technical consultant, structural consultant and internal technical consultant. It was a non-intervention approach, mainly observing, collecting, describing and organizing data. The data-collection comprised observations at the meetings of the steering group, document analyses of documents and drawings that passed the meeting or were referred to in the meeting, and interviews with all members and past-members of the steering group just before the completion. This study explored to what extent issues that could be traced back to interpretative, functionalist and the connection between interpretative and functionalist perspectives were actually used in the design discussions.

The case study at the community-based pharmacy was a single case study set up in a quasi-experiment and dealt with the launch of a new concept store for the Dutch market by a large European pharmaceutical company. The study comprised non-intervention and intervention approaches.

First, the study included non-interventionist observing, collecting, describing and organizing functionalist data. The functionalist perspective focused on a systems image of the old situation, the ‘ist’. In this case: workflow and acoustics. The workflow was addressed with observations and staff measurements on the number and nature of prescriptions dispensed (5 items), on the lead times per patient (4 items), the tasks performed (14 items) and the number and nature of the conversations at the counter and in the private room (14 items). Information on acoustics was obtained with a sound level meter Rion.

Second, the study also included interventionist discussing, arguing, agreeing and disagreeing in the interpretive, emancipatory, postmodern and critical parts of the study, which was also used to reflect on the earlier collected functionalist data.

The interpretive perspective was used to make the future strategy explicit, the ‘soll’. The structure of interactive planning was followed (Ackoff, 1999). This approach was used to create a concise overview of the concept behind the new design in sessions with the national management, the local management and the architect. Three stages of Ackoff were used here: formulating the mess,
planning the ends, and planning the means. The first stage ‘formulating the mess’ provided a general overview of the organization and its environment. The second stage ‘ends planning’ was used here to define a current state and an ideal state of the pharmacy organization. These two states were all defined in terms of products and services, communication, building, location, management, marketing, prescription drugs, non-prescription drugs, customer population, personnel, working system and competition. The third stage ‘means planning’ was used to define the exact properties of the concept store with a special focus on the properties which were expected to bring the current situation closer to the ideal situation. For privacy reasons, only the most relevant results will be given: strategic results which were actually used in connection with the architectural design.

The emancipatory perspective was also used to have a systems image of the old situation, the ‘ist’. The personnel satisfaction was derived from questionnaires on general staff satisfaction (78 items), staff satisfaction with the building (46 items) and interviews on current problems. Moreover, we included participatory design of staff in immersive virtual theatre in the postmodern perspective. Although we also intended to include a participatory design approach with customers in the decision-making of the new pharmacy also, the company did not really warm to this plan. What if the customers would propose plans the company did not like? How to prevent disappointment of the customers? Moreover, the data collection was very late in the design process, only weeks before the actual construction process. It was hard enough to make any change at all. Although direct involvement of customers was not possible in this case, we did use the results of the customer satisfaction questionnaires (61 items) and the customer behaviour in the waiting area (10 items) in order to include at least some ideas from the emancipatory perspective.

The postmodern perspective was applied in a combination of digital photography and immersive virtual reality (VR). The photographic material of the old situation was collected with an electronic camera Canon Powershot S50. The images were made of the old building, staff and customers. In the study, immersive VR was used to create a lively image of the new pharmacy building and human behaviour within it, by using a 3D model. The model was made with OpenGL. The virtual pharmacy was presented in a virtual theatre. The theatrical structure allows 20 people to assess the design quality simultaneously. In this theatre, stereo images are projected on a cylindrical screen with three projectors. The projection comes from a position above the audience, like in a cinema. The stereo effect is created with shutter glasses, which can switch from fully transparent to opaque. If the right glass is transparent, the left is opaque, vice versa. The right glass is transparent when the right eye stereo image is projected, while the left glass is transparent when the left eye stereo image is projected. The refresh rate of the projectors and the shutter glasses is 96 Hz. This frequency is sufficiently high to create an illusion of 3D. An important feature is that the interior can be changed real time allowing a debate about its assumed consequences. The postmodern approach was meant to immerse the team in the 3D design as such, to have fun and to hear the related ideas of the architect and the management. It was meant to be a ‘triggering event’ for creative thinking about a possible future. In this first part, the design team made a virtual walk through the ‘empty’ architectural design and through the architectural design filled with agents both full screens in a 2-h morning session. The agents were agents, in this case cardboard puppets, representing elementary movements of humans in the 3D design. They represented customer behaviour in the waiting area and staff behaviour according to the pre-defined working systems. Repeatedly we asked questions like: where does the new design improve the old performance, where not and where do we need to change the interior design? By doing so, it was not only fun to do, the virtual theatre is a great experience, but also it stimulated the debate and shed new light on the expected quality of the design.

The critical systems perspective was used to structure all the collected data in the specific context of organizational and architectural
design. Therefore, the last part of the study combined the results from all earlier systems perspectives in the virtual environment. It allowed new light to be shed on the design and to critically evaluate the design in a 3-h afternoon session. The combination of four perspectives served three goals: assessment of the design, intervention in the design and overall evaluation of using the critical systems perspective in an immersive virtual environment.

In the assessment of the design, the messages from the different data were compared with the problem-solving effects of the new 3D design. The organizational problems addressed in the old situation were combined with the digital images of the old situation which were projected on one of the three screens as a reminder of the old pharmacy. The agenda of the session was set by these research data. The new 3D design was projected on the remaining two screens, allowing detailed analysis of many aspects of the design, and differences between the old and the new pharmacy.

In the intervention in the design, the main questions were: Would the design be changed after the virtual session at all? And if yes: Where and why would it be changed? Even though the 2D design appeared well considered and the session was very late in the construction process, the group was explicitly invited to make interventions that seemed sensible at this stage of the construction project. The researcher recorded this list of interventions and related arguments.

In the evaluation of the virtual session, the usefulness of this specific approach in an immersive virtual environment was investigated. First, the design team assessed the quality of the design in a questionnaire in a separate classroom before and after the visit to the virtual theatre (35 items). A 10-point scale was used to give a report mark per item. Next, at the end of the day, the general satisfaction with the visit was measured. A 10-point scale was used to give a report mark on this item. The respondents were also invited to give arguments for this judgement. Finally, based upon the list of proposed interventions, the architect estimated the imaginary costs of these interventions (on the condition that it would be performed after completion of the building), and all participants were asked to make a cost calculation of their own efforts. Moreover, during the virtual session, observations of the discussion were made and recorded.

IMPLEMENTATION

The Design of a Paediatric Department

This first study explores if and how the interpretative perspectives may be connected with the functionalist ones. The interpretative ideas were formulated by the management of the hospital and show the influence that an organization may have on functionalist architectural design. The management intended to stimulate hospitalized children in doing something else than only lying ill in bed. It was decided that the architect should plan the children’s city on the roof of the hospital: Ronald McDonald VU Kinderstad, close to the paediatric section of the hospital (Meijer, 2003). Together with the Royal Institute of Dutch architects, the hospital organized an open competition for young architects.

The management argued that a positive and playful environment stimulates the recovery of the patient child: ‘A child should be able to behave as a child. In addition, long-term illness affects the physical growth as well as the intellectual growth negatively. It is very important that children learn the right things at the right time. Therefore, a meeting place with other children is vital for their development’ (Meijer, 2003: 15). In this meeting place, children from the clinic and outpatients’ clinic mix with infant visitors. The interpretive vision for this design was that ‘the meeting place should stimulate the children’s intellectual growth, and at least for a part of them, aim to distract them from their illness’. Key in the organization’s interpretive vision was intellectual growth and distraction during hospitalization. It goes without saying that the target group of infants is very diverse. The users vary from 0 to 16 years of age. Consequently, an important included functionalist design principle was multi-functionality. The design must create space not only for everyone,
but also respect the fact that an adolescent usually does not play with a pre-schooler. Different programmes in various rooms do take place in different rhythms. Specific activities are organized daily, other activities like a theatre performance weekly, and yet other activities like a market at Queen’s anniversary day or a Christmas market yearly. The managerial vision on architecture was that the City of 630 m² should comprise various thematic rooms in order to fulfil its strategy. For example, at the football ‘players home’ of Ajax Amsterdam, it was envisaged that the children play table football. Every now and then, they would have the possibility to have a conversation with players and ask for a signature. In the ‘spotters nest’, the children can watch climbing and landing aeroplanes of the near airport Schiphol and see the according radar data on a screen, while others follow animals of the Amsterdam zoo on a webcam. In the theatre, a clown can give a joyful performance, and for the ones which need a quiet place to relax, a special ‘snoezel’ room will satisfy their needs with the soft sound of the sea.

The winning design of Sponge Architects and Rupali Gupta for the VU University Medical Center in Amsterdam, The Netherlands shows the firm grip of the management on architecture, images of which can be found by searching for images of ‘VU Kinderstad’ with Google™. The images confirm that the connection between the interpretive organizational concept from above and the functionalist architectural design was strong and fairly consistent. The transformation from the interpretive vision, in this case, the intended stimulation of children’s intellectual growth and distraction during hospitalization, into functionalist architectural solutions has been prepared very well.

The Design of a Holiday Residence for Children with Life-Threatening Diseases

This second study also explores if and how the interpretative perspectives may be connected with the functionalist perspectives. Villa Pardoes is a holiday residence for children with life-threatening diseases. It aims to help these very ill children. It is based upon the US concept of ‘Give Kids the World’. The interpretive vision on this design was that ‘the villa should provide relaxation for very ill children between 4 and 12 years of age and stimulate contact between partners in adversity’. It was found that ill children like to be together for a week, but only under the condition that their family is around. This idea is expressed in close connection with organization and building.

The interpretive vision on relaxation can be derived from the functionalist domestic regulations, a basic organizing principle. For a week, the child and the family are pampered mainly through volunteers. The first evening they are offered a buffet. The other evenings they cook themselves in brightly coloured kitchens. The children and their family can stay for free. The family can also enjoy other facilities in the area. Five amusement parks, but also neighbouring theatres and museums allow free access for the families. Although the apartments are completely adapted to the special circumstances, the visual presence of medical devices is minimized. It is stressed that families do not need to be confronted with their child’s illness unnecessarily. Specific devices, for instance, lifting devices, shower stretchers and resuscitators are, therefore, only available upon request. The interpretive vision on relaxation can also be derived from the interpretive architectural guiding principles and related functionalist interior design. For the interior architecture, themes as fantasy and nature were used as interpretive guiding principles to provide relaxation. These principles were transformed into functionalist architectural forms, materials, colour and light. By doing so, the building was not adapted to the needs of children, but uniquely designed and constructed for children that need distraction and precious time to play.

The main architectural fantasy of the big villa is a snail’s shell. The central hall is filled with toys, plants and small sculptures. It does explicitly not relate to the aura of a hospital, although it is highly sophisticated if medical equipment is necessary. A snail track is used for signposting.
The snail’s shell also includes various common spaces where families can meet, talk, eat or play at a computer. The shell comprises eight apartments with three bedrooms each. The rooms have themes like ‘Barbie’ and ‘Beach’. In the Barbie fantasy, everything is pink instead of the hospital white. All interior details refer to the Barbie dolls. The room is extremely popular among young girls. In the nature rooms of the ‘Beach’ theme, the colours and the furniture refer to sand, sea and shells. Other atmospheres are created by the images on the glass of the skylights, for instance, the fairy tales from the close located amusement park ‘De Efteling’ and the appearance of small leaflets. If the sun shines, the shadows of the leaflets emerge on the wall. It then appears as if the house is in the middle of a forest, images of which can be found by searching for images of ‘Villa Pardoes’ with Google™.

The interpretive concept of mutual contact is worked out by the organization principle that the staff of the villa decides which combination of families may be the most suitable. The age of the children is dominant in the decision for combination, mainly to stimulate the possibilities for friendship between the children. In the interior space, the convenient and safe arrangements stimulate mutual contact. Parents do not need to pay attention all the time. They can talk with partners in adversity while the children do whatever they like to do in a safe environment.

This case shows how strongly organization and architecture are blended, and how consistently the interpretive and the functionalist design were interwoven. The properties of the organizational and architectural systems consistently express the interpretive vision of relaxation and mutual contact, an apparent bridge between the interpretive and functionalist design practices.

The Design of a Community Hospital

This third study explores to what extent issues that could be traced back to interpretative, functionalist and the connection between interpretative and functionalist perspectives were actually used in the design discussions (Table 3). The community hospital designed both a completely new building and renovated parts of its old premises.

The interpretive perspective was unpopular: both on meaning and change. The meaning of the hospital organization and the effects of possible change were hardly discussed. The architect introduced a study of different auras and atmospheres with images of other buildings to stimulate the debate, but the response of the decision-makers was very poor. There was no profound debate and no interest whatsoever at the side of the hospital to debate these issues. The hospital failed to raise a fundamental discussion on issues like atmosphere, aura and its basic values and beliefs in this context, a missed opportunity that should have been applied more respectfully. It could have allowed the hospital to let organization and building converge more intensively. As such, the knowledge and the creativity of the architect were not used to its full potential. Consequently, the architect decided where and how to make interventions in this interdependent system. Moreover, the possibi-

<table>
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<tr>
<th>Perspective</th>
<th>Interpretive</th>
<th>Functionalist</th>
<th>Interpretive and functionalist</th>
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</thead>
<tbody>
<tr>
<td>Issue</td>
<td>Change, meaning, symbolism, corporate identity, culture, atmosphere, aura, flexibility, perception</td>
<td>Cost, volume, surface area, market share, workflow, organizational interdependencies, logistics of patients, staff and goods, staffing, congestion</td>
<td>Coherence between interpretive and functionalist issues</td>
</tr>
<tr>
<td>Debated?</td>
<td>Seldom</td>
<td>Frequent</td>
<td>Not</td>
</tr>
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Table 3. Observed issues related to interpretive and functionalist perspectives
lities of future change in the hospital were neglected to some extent. Most important 'judgements of fact' were frozen, mainly to bridge the gap between the fluid social system with the principally static architectural form. This can be understood since the architect has to find a workable basis. Moreover change can also be addressed after completion, for instance, for budgetary reasons. However, a very poor development if it comes to sustainability. The fit between hospital and building was poor both on large and small facts: with the completion of the building, there were 15 000 patients more than expected, new disciplines were observed, just as new organization structures (closer connection between outpatients' clinic and day treatment) and changes in the hospital departments (growth and shrinkage of disciplines). The result was that the current building is too small and not flexible enough to incorporate all the changes without reconstruction. Although it is doubtful if all issues would have been taken care off by taking the interpretative perspective more seriously in the debate, it would at least have raised the awareness of meaning and change in some of these situations, which may then not have been so unexpected after all.

In contrast, the functionalist perspective, especially the omnipresence of hard calculable facts, was vividly present in all debates. Almost everything in the discussions was in the end reduced to $m^2$, $m^3$, € and estimated market share expressed in numbers of patients. Other functionalist design principles were decisions based on interdependencies and workflow. Departments with strong dependencies, for instance, the operating rooms and the sterilization room for instruments, were positioned close together. Other horizontally and vertically applied principles did relate to workflow. For instance, in the horizontal principle, a high score on patient traffic and patient immobility did secure a position close to the central hall. Consequently, the outpatients' clinics with most visitors, like internal diseases and surgery, had a priority for a position close to the entrance. Other departments with immobile patients, like orthopaedics, were also closely located to the entrance. Moreover, in the vertical principle, a high score on human traffic did secure a position on the ground floor. The outpatients' clinic with the highest frequency of patient visits on the ground floor, the clinic with mainly visitors on the first, the operating facilities with internal traffic on the second and the technical installations with the lowest frequency of visits by maintenance engineers on the third floor.

The connection between interpretative and functionalist perspectives was almost absent. A profound debate about the interpretative meaning of the hospital and possible changes in relation with the very popular functionalist calculable facts on process and outcome was not observed in organizational and architectural design.

This study has revealed a strong focus on the functionalist perspective, little attention for the interpretive perspective and no profound debate on the connection between the functionalist and the interpretive perspectives. Consequently, the hospital management missed a wonderful opportunity to have influence on the design decisions of the architect, especially on the interpretive perspective and the connection between the interpretive and functionalist perspectives in order to connect organizational with architectural design.

The Design of a Community-Based Pharmacy

In the first three cases, we applied only the interpretive and functionalist perspectives. In the last study at a community-based pharmacy, it was decided to develop a closer connection with CST to ensure that all perspectives were included. This fourth study must, therefore, be regarded as the implementation of the critical systems perspective: using and combining all four systems perspectives. Thousands of data have been collected during 2 months. In order to keep this current description within the limits, the most important results are summarized in Table 4.

The interpretive perspective showed that the concept store was expected to improve the customer satisfaction. Three different sessions
were planned: one with the manager pharmacy services and development and the area manager at the head office, one with the local store manager and one with the architect. In all sessions, we defined the current and ideal design, as well as the activities that were expected to bridge the gap between current and ideal. In the ideal designs, we identified three common aims: decrease of lead times, more inviting atmosphere for asking questions and more space for non-prescription drugs. More or less apart from the construction the logistic tasks were robotized, which was

<table>
<thead>
<tr>
<th>Systems perspective</th>
<th>Issue</th>
<th>Focus</th>
<th>Result (N)</th>
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</table>
| Interpretive        | Strategy | Concept store | - Decrease of lead times  
|                     |         |         | - More inviting atmosphere for asking questions  
|                     |         |         | - More space for non-prescription drugs (4)  |
| Functionalist       | Workflow | Dispensed prescriptions | 44% waiting for whole dispensing process, 37% collect only, 19% home delivery (3033)  |
|                     |         | Mean waiting time | 311 s (1783)  |
|                     |         | Mean lead time | 621 s (601)  |
|                     |         | Performed tasks | 22% filling, 13% pause, 12% counter, 11% computer, 42% other tasks (2665)  |
|                     |         | Number and nature of counter conversations | 51% brief information about medication, 10% first issue, 26% no information, 23% other conversations (1197)  |
|                     |         | Number and nature of conversations in private room | None  |
|                     | Acoustics | Counter | Resonance 0.3 s, decrease 5.5 dB per doubling (1)  |
|                     |         | Waiting area | Resonance 0.3 s, background sound 24 dB(A), decrease 3 dB per doubling (1)  |
| Emancipatory        | Personnel | Interviews: general | Positive atmosphere, high working pressure, communication problems with head office (14)  |
|                     |         | Satisfaction rate: general | 7.2 (11)  |
|                     |         | Satisfaction rate: building | 4.9 (10)  |
|                     |         | Satisfaction rate: general | 7.9 (81)  |
|                     |         | Behaviour during the wait | 74% wait only, 11% look at/grasp products, 8% conversing with others waiting, 6% remaining activities (1828)  |
| Postmodern          | Old building | How does it feel? (digital images) | Wonderful experience, improved understanding of the design, profound debate of fact and value, emancipation, increase of common ground, 10 interventions in the design, €5000 imaginary cost reduction, session satisfaction rate: 8.1 (8)  |
|                     | New building | How does it feel? (virtual model) |  |
|                     | Working system | Does this do what we want? (agents of staff and customers) |  |
| Critical            | Organizational space | Does it improve significantly? (pluralism with all previous perspectives) |  |
expected to decrease the lead times. The second and the third contributions were expected to be changed with the interior design of the concept store.

The functionalist perspective provided us with an enormous quantity of data, some of which can be found in Table 4. Although the results showed many interesting issues, the most important problem was privacy at the counter, especially in connection with the interpretive ideas for more inviting atmosphere for asking questions. The acoustic measurements showed that the background sound was very low, the decrease of sound from counter to waiting area was also low and the resonance was normal. Therefore, it was concluded that counter conversations could actually be heard by other waiting customers.

The emancipatory perspective confirmed the privacy problems at the counter. The staff had very serious complaints with the acoustics. They had the feeling that conversations could be heard by others waiting. This feeling was confirmed by the customers. Be reminded that the acoustic measurements confirmed this perception.

The postmodern perspective comprised the 2-h experience of walking through the 3D design, 3D design including human behaviour, and images from the old building. It was received with great enthusiasm. It was found best to start with a virtual walk through the empty virtual building and to continue with the 3D model filled with simple agents. It was easy to confirm that the space for non-prescription drugs would actually increase by comparing the old with the new space.

The critical systems perspective comprises the assessment of the design, intervention in the design and evaluation of the virtual session. Basically, it combined facts and values about the current and future state of the system. The data about the current state of the system comprised the functionalist perspective (workflow and acoustics), the emancipatory perspective (personnel and customer) and postmodern perspective (digital images). The data of the future state of the system comprised the interpretive perspective (strategy), the postmodern perspective (virtual model of the building and expected human behaviour). CST was used by combining all these perspectives: one screen with the functionalist, interpretive and emancipatory data and two screens to project the hyper-realistic simulations of the postmodern perspective. The future state was confronted with the properties of the current state of the system, continuously asking the question: does it improve significantly? Below, the results of implementing this approach are described.

Assessment of the Design

Especially, the combination between the different perspectives was very powerful. Where the interpretive perspective revealed a wish for a more inviting atmosphere for asking questions, did the functionalist and emancipatory data reveal acoustic, staff and customer satisfaction problems, at the key place to ask such questions: the counter. The postmodern hyper-realistic simulation and images of the old building allowed the decision-makers to assess that the situation would not improve, but rather worsen in the new pharmacy building: two counter points were even closer than in the old interior. Moreover, the real-time interventions in the architectural design were well received. It was possible to move the counters in the model, however, due to a construction post not possible in reality. However, it provided the team with new design opportunities, even though, as was mentioned above, the virtual session was very late in the construction process. The combinations which stemmed from the pluralism of the critical systems perspective did raise their curiosity about an alternative but possible future.

Intervention in the Design

The proposed interventions based on the critical systems perspective comprised 10 items, which are indicated in Figure 1. Here, we have finally arrived at and implement specific positive change proposals. Be reminded that the perspective on the future with the applied interpretive systems revealed that the pharmacy should have a more inviting atmosphere for asking questions.

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and more space for non-prescription drugs. Most items related to privacy, atmosphere and space.

The first three interventions were in the prescription area. These items were expected to contribute to privacy and an improved atmosphere for asking questions. The first item was a privacy line in the paving tiles (1). This intervention was supposed to improve the privacy by increasing the distance between the customers helped and the ones waiting. The second item was not usage of one of the counters (2). This intervention also was assumed to improve the privacy by increasing the distance between the customers helped. The third item was a purchase of audio installation to make background music possible in the waiting room (3). This was assumed to improve the privacy by reducing the possibilities and feeling to listen in with an increase of noise.

The next three interventions were in the non-prescription area. These interventions were expected to contribute to more space for non-prescription drugs and an improved atmosphere for asking questions in this area. The fourth item was switching one of the counters from a position close to the entrance (4a), to a new position (4b), which is closer to other counters (4c). This was expected to improve an atmosphere of accessibility and openness for the customers and a safer and more efficient working situation for the personnel. It was assumed to be more accessible and open because customers would look at a face rather than at a back when entering the pharmacy, and to be safer and more efficient because the personnel was working closer to the other counters.

The fifth item was a new sign with the text: ‘information’ above the switched counter (4b). In the discussion, it became clear that the information function of the non-prescription area (5) was an important innovation in the new pharmacy concept. The latter intervention was assumed to create a clearer signposting. The sixth item, in relation with the assumed information function of the non-prescription drugs, was a placement of an extra display for the provision of information (6).

The last four interventions were both in the non-prescription area and in the prescription area. They were remaining items: items that could not be directly linked to the data from the interpretive and functionalist systems approaches, but were a logical consequence of the earlier interventions (items 7–9) or a separate
intervention (item 10). The seventh item was the placement of a magnetic gate at the pharmacy entrance (7). Due to the switch of the counter, it was assumed that it had become easier to steal products due to the counter switch, since the personnel was less close to the entrance, and the customers did feel the immediate presence of the personnel less. The eighth item was to remove a floor part (8). Due to the switch of the counter, this part of a designed floor was redundant. The ninth item was to remove two drawers and a display (9). Due to the switch of the counter, this change was found more beautiful. The 10th item was a change of colours of the wall in the waiting room (10). This intervention, orange instead of white, was assumed to create a friendlier and more sparkling atmosphere.

**Evaluation of the Virtual Session**

It was observed that for the staff of the working floor, the virtual session was a very important moment to exchange ideas with the management and the architect and influence the design. This was a power, which the staff had not felt before in the design process. This approach was full of emancipation. First, it allowed the lays (non-architects) to understand the architectural design and imagine possible organizational consequences. Second, it allowed a genuine debate which did not only include the powerful involved in the design process (the design group of management and architect), but also those affected most heavily but not involved until the virtual session (the workers). By doing so, the organization build on the understanding of and commitment for the new concept store. As such, this approach included the engagement with emancipation of the critical systems perspective.

The evaluation questionnaire had a Cronbach’s alpha of 0.96, indicating that the internal consistency of the questionnaire was good and that it may be regarded as a reliable source for information. The response was 89% (eight out of nine), as one of the members of the management team had to leave early. The results of the questionnaire, which was filled in before the virtual session, showed a report mark of 6.9 for the design based on the 2D architectural drawing. The standard deviation of the mean was 0.42. At this stage, 6 out of 8 respondents (75%) could not estimate the quality of the design of 22 out of 35 design items (63%) in advance. The two respondents not having problems with an assessment of any of the items were the local pharmacist and the area manager. Both were the most heavily involved managerial decision-makers in the design process. The architect could only not assess if the pharmacy is going fine and if the design was personnel-oriented. The rest of the pharmacy personnel had problems with 20 out of 35 items (57%). The results of the questionnaire, which was filled in after the virtual session showed a higher report mark of 7.4 for the design based on the 3D immersive VR. The standard deviation of the mean had increased to 0.48. At this stage, 4 out of 8 respondents (50%) could not estimate the quality of the design of 8 out of 35 design items (23%) after the virtual session. All of these respondents, which could not estimate the design quality after the virtual session, were also not able to estimate the quality of the same items before the virtual session. So, at none of the cases, the possibilities to make such an assessment was worsened. The differences between the results before and after the virtual session for all respondents showed an increase of the mean for all items (0.5). The standard deviation of this mean increased also (0.06). However, the paired-samples t-test, in using a 95% confidence interval showed that the increase of this mean was not significant. Detailed analyses of the differences per item showed that the standard deviation did not change at 6 items after the virtual session, increased at 11 items and decreased at 18 items. At only 9 out of 35 items (26%), the observed change was significant. A significant increase of the standard deviation was observed at the items: customer-oriented and information work. With respect to these two items, a decrease of common ground was observed due to the virtual session. A significant decrease of the standard deviation was observed at the items: mood on the working floor, mood at customers, perceived waiting time, place of the waiting customers, seats, computer work and innovation. With respect
to these items, an increase of common ground was observed due to the virtual session. In addition, all respondents argued that the 4-h trip (400 km there and back) was worthwhile. The general satisfaction with the visit was 8.1. The architect estimated the costs of above interventions, if performed after completion of the building (which we may, therefore, safely label as imaginary costs) on €23,000. The cost of the virtual session was €18,000. This cost comprised the extra 3D drawing work of the architect (€10,000), the computer animation and programming work (€6,000) and the visit of the design team to Groningen and their stay at the University campus (€2,000).

We may conclude that we have arrived at specific change proposals by using the logic of the critical systems perspective. Especially the pluralism has allowed the design team to gain new insights in an area which was well-known to them, although in other dimensions: literally and metaphorically. An important effect was the emancipation of the staff. Stimulating fairness and empowerment of the workers. They were not involved in earlier stages of the design process and their opinions were actually included in the decisions. This all raised the critical awareness of the stakeholders: it created a climate within which systems perspectives were well received, and were actually used to improve the situation at hand (in contrast with the observations at the community hospital).

CONCLUSION

CST was used as a perspective on organizational and architectural design. It seems safe to argue that this approach increases the understanding of what a true interdisciplinary design in organization and architecture may contain. Different spatial and organizational data can be combined and analysed by using CST. It can support the manager with her work in this special context both by taking pluralism and emancipation seriously. Especially the methodological pluralism allows very different insights in the matter which in turn stimulates the making of significant improvements. It raises the awareness about possible organizational consequences in a building and also stimulates broad participation of the stakeholders.

Moreover, VR is a meaningful and valuable approach to be used in combination with CST. It is an inspiring approach which can be used in combination with a mix of all sorts of facts and values around the current state and expected future states of organizational space. Managerial decision-makers engaged in construction of reconstruction processes should be aware that a combination of CST with VR can improve the quality of their building designs. By doing so, the assumed environmental constraints to which their ideas on a possible future are subject, such as the link between interior design and organization structure, do come in the direct sphere of influence of the decision-makers. For organizational and architectural sciences, the VR-CST connection may also be an interesting opportunity to improve the relation with practice. VR has a great appeal to practitioners and may lead us to a new method of inquiry. However, we also have to be cautious. Just a simple discussion of design images does not really help anyone. VR is in need of scientific sub-titles, in this context is the connection with CST vital: facts and values that allow an argument about why a possible future state may or may not be worthwhile implementing. More studies will have to be made, for instance, to search and define the best methodological and methodical combinations within CST, the most fruitful discussion structures and stimuli for VR, and the design decisions that have the most positive impact on organization processes and performances.

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REFERENCES


A Perspective on the Design of Organizational Space


