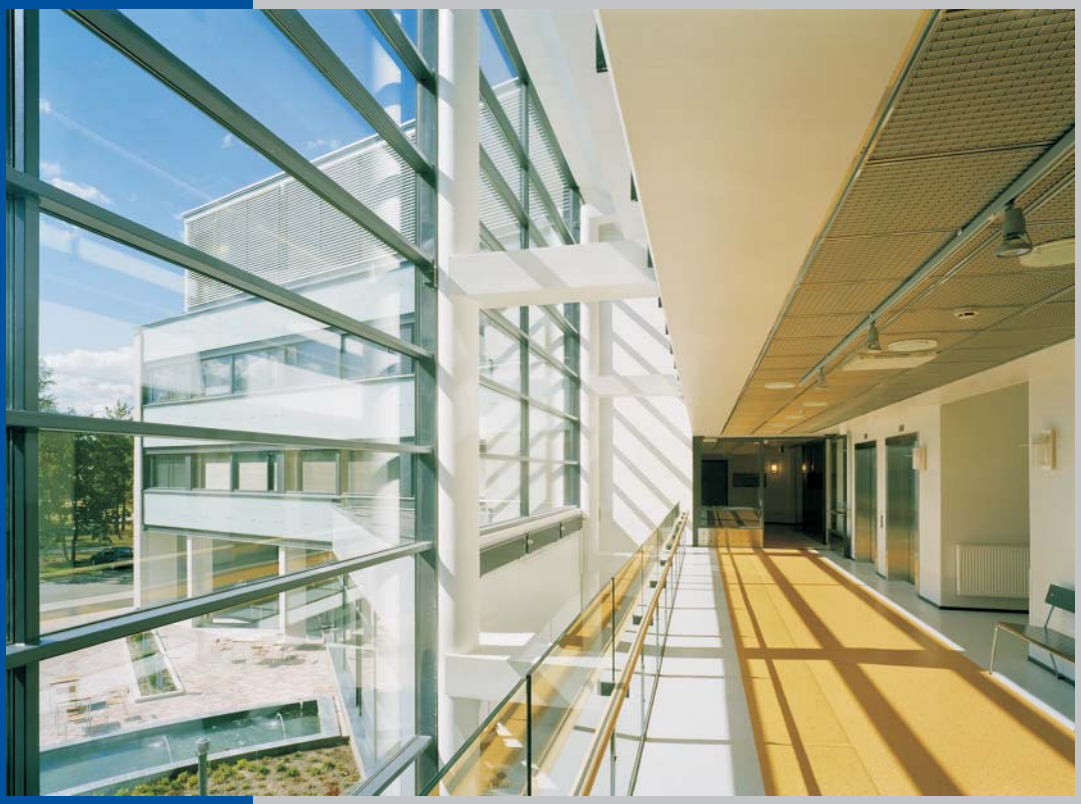
Ari Pennanen

Workplace Planning



USER ACTIVITY BASED WORKPLACE DEFINITION AS AN INSTRUMENT FOR WORKPLACE MANAGEMENT IN MULTI-USER ORGANIZATIONS

ARI PENNANEN

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Supervised by
Professor Juhani Katainen

Reviewed by
Professor Glenn Ballard
Professor Leen van Duin

Publisher:
Haahtela-kehitys Oy
Tinasepäntie 45
00620 Helsinki
eMail: firstname.surname@Haahtela.fi
internet: www.haahtela.fi

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ABSTRACT

In the corporate real estate business, spaces are treated as functions of the operational process; use of space is integrated into core business operations. On the other hand, the building sector ultimately produce the user's functional environment. In this research these perspectives are considered together in a Workplace planning concept. The systemization of a workplace planning concept consists of three parts:

- the Theory of Workplace Planning
- the Steering Model of Workplace Planning
- The Workplace Planning Procedure

The Workplace Planning Theory links workplace planning to production. A spatial investment in an operation competes for the same recourses as the other investments in the operations. Workplace planning is a process where valuable requirements for workplace production are determined through observing and evaluating the values of stakeholders against the organization’s strategy.

The Workplace Planning Steering Model fulfills the theory’s principles in practice. The Workplace is linked to a very complex system; sets of goals, a wide range of needs, the different viewpoints of the owner and user etc. The created steering model is based on dialogue between strategic and operational management. It encourages learning, group working, transparency and the elicitation of viewpoints. It supports strategic and operative management’s collaboration and mutual commitment forming. It also underlines accountability by creating feedback loops between decisions and outcomes. It enable the reduction of unnecessary investments and thus releases resources for more important operations in the organization’s strategy.

A steering model requires rapid feedback. The Workplace Planning Procedure models the need for space based on the temporal load of activities and on the geometric actions within a space. It gives the number of rooms, their sizes, functional possibilities and utilization degrees. The procedure enables the budget to be directed away from pure spaces, and back to the activities which enable activity-based cost management.

In case studies the workplace planning concept has led to shared understanding and mutual commitment between owners and users. It has also led to a remarkable reduction in the use of spatial resources.

ACKNOWLEDGEMENTS

This research is a cross-disciplinary study of architecture, construction economics, production and complex social decision making. It has required open-minded guidance and empathy to the values of customers, users, owners, architects, managers, financiers etc. I am grateful to Professor Katainen and Professor Salokangas for reflective research meetings and for creating such a research environment. Professor L. van Duin from the Delft University Faculty of Architecture assisted me in concentrating on the essence of the structure of the research. Professor Ballard from the University of California at Berkeley encouraged me to study workplace planning in the context of production theories, which appeared to strengthen and simplify the theory of workplace planning. I had valuable theoretical one-to-one research meetings with Professor Koskela from the University of Salford. I am especially grateful to all of these.

It is clear that the unique working environment within the Haahtela Group has created a profound understanding of the values of stakeholders covering the whole construction process. As a project manager I have been able to communicate directly with customers who require workplaces, with architects, with other designers, with site organizations, with contractors and, again, with the customers who use these workplaces. The Haahtela Group also is a center of innovative research, as a third of all employees work on development tasks. I am grateful to Yrjänä Haahtela, Harri Väänänen and to all my colleagues. This research would not have been possible without them. This research is now complete but we will go on together to meet new challenges in the future.

Tekes (National Technology Agency of Finland) recognized the importance of strategic and operational based workplace planning far in advance of any results of the research. I am grateful to Director, Dr Ari Ahonen and to Tekes for allowing access to their network of collaborative international organizations and for their financial support. Our co-operation will continue.

It is sometimes hard to evaluate the outcome of customer behavior if the researcher is himself influencing that behavior. My fellow researcher, Dr Michael Whelton from UC Berkeley, was of great help when conducting parallel research as an “outsider” with the same customers. He also assisted me in finding more theoretical background. During the course of our work together, we became firm friends. Thank you Michael.

The relationship between Workplace planner and customer leads to a process

of mutual learning. I have learned much. I am grateful to Arcada, Senate Properties, Jyväskylä Polytechnics, Stadia, Synapsia, Neuro, the Municipal Federation of Education in the Jyväskylä District, Jyväskylä City, HEX, Helsinki Lutheran Church…there are so many. Without its value in practical use this research would lose its importance.

I would like to thank my wife Heli and my daughters Aino and Elena. You have supported me in my life and thus in meeting this challenge. Thank to my parents, Liisa and Antero, and to my sisters Riitta and Saara for waiting so patiently for my almost-ready dissertation.

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1 INTRODUCTION

1.1 Workplace Planning

The definition “workplace planning” has been used in particular in connection with Corporate Real Estate (CRE). Workplace planning is a continually updated resource allocation in relation to the working environment, its users and the organization’s strategy (Horgen & Joroff & Porter & Schön). In workplace planning the production of spatial resources is integrated into the core business operations. The concept of the workplace as a functional environment contrasts with the idea of the building as just a structure. (Joroff 2001).

A spatial investment in an operation competes for the same recourses as the other investments in the operations (Pennanen 1999). In general business administration workplaces tend to be seen as one of the components of production. Spaces are treated as functions of the ongoing operational process. In the modern world the organization as a whole is often challenged to rethink it’s central mission, its assumptions and strategies, so the spaces within which the organization operates and the manner in which those spaces are created and used are equally subject to challenge. The current situation can continuously be reviewed (Horgen & Joroff & Porter & Schön).

Drivers of change are new business strategies necessitated by the changing business environment. The most important contributions of workplace planning to business objectives are

- Access to qualified workforce
- Workplace efficiency and productivity
- Cost reduction (Lambert & Poteete & Waltch 1995)

Workplace planning can also be studied through production theories, which leads to the same goal. Production theories aim to improve the production process and the value of the product (working environment) to the customer (Koskela 2000).

The creation of an effective workplace requires collaboration between stakeholders with different interests, freedoms and powers. (Horgen & Joroff & Porter & Schön 1999: 7). The basic premise is for workplace management to have an interactive effect on business strategy, e.g. ”the workplace manager operates on the board of directors” (Joroff 2001).

This perspective on workplace planning is understandable since a workplace affects productivity, whilst the working environment represents a large share of the use of resources. Space expenses (investment + maintenance costs) vary from 5 to 30 % of all expenses of an organizations (among offices and schools) (Kuntien kiinteistötalouden kehittämisohjelma, yhteenvetoraportti 1997). Indeed, workplaces are a significant investment in an organization's strategy.

1.2 Practical Problems in Implementing Workplace Management to Project Definition

1.2.1 Project Definition methods

The construction industry has traditionally focused on situations of change, and spaces are treated as functions of the production process. Building professionals, programmers, planners, building consultants, and contractors, ultimately produce the user's functional environment. The main focus of the management system emphasizes that area in which each party's strongest professional competencies lie. Once the rooms needed and the spatial requirements are defined by the client, production economics are well controlled, as are economics in early design phases. However, interfaces between different users, user processes, business operations, business strategy and management of spatial resources is an unfamiliar concept. The head of personnel, rather than a construction professional, plans workplace strategy. (Pennanen 1999).

Sanoff has presented a conclusion of seven programming methods widely used in the USA for project definition (Sanoff 1989). They are well documented and their processes are well described:

- Davis & Szigeti (1986)
- Farbstein (1985)
- Kurtz (Preiser 1978)
- McLaughlin (1976)
- Molenski (Palmer 1981)
- Peña et al. (1987)
- White (1972)

It is hard to define the "traditional project definition method". Problem Seeking, an architectural programming primer (Pena et al. 1987), is one of those seven methods Sanoff has studied. It covers most of the processes covered by the others. It can therefore be used as an example of today's architectural project definition.

1.2.2 Problem Seeking, an Architectural Programming Primer

According to Problem Seeking (Pena et al. 1987) programming consists of five steps:

1. Establish goals
2. Collect and analyze facts
3. Uncover and test concepts
4. Determine needs
5. State the problem

The problem stated must be identified in areas of

- Function
- Form
- Economy
- Time

Framework for information handling and guideline for decision making

The programmers do not have to know everything the client knows, but they should know enough of the client's needs, conditions and ideas to have an influence on the design of the building. For this, programmers have to know the right questions to ask; so they start with thirty-six sub-categories. This framework is useful in avoiding information clogs when dealing with massive quantities of information, it can be used as a checklist. The framework can be extended to serve as an Information Index, a one-hundred-thirty cell matrix of key words to be used to acquire the appropriate information.

Good programming is characterized by decision making by the client. The programmer must stimulate client decisions, he may have to evaluate the gains and risks. Who will actually make which decisions? Generally, he who has responsibility for the outcome has the authority to make decisions. The programmer must interview this decision maker and then ask for his approval of the program.

Goals

Goals are important to the designer, as he will not find inspiration in a list. Goals must be tested for relevance to a design problem and not to a social or other problem.

Collect and analyze facts

Facts are used to describe the existing conditions of the site. Other important facts include statistical projections, economic data and descriptions of the user characteristics. When the programmer asks questions he must separate fact from fiction. He must find out the truth. He must tell the difference between

established fact and mere opinion. He must evaluate opinions and test their validity.

Concepts

Concepts indicate how the client wants to achieve goals; goals are implemented through concepts. Programming concepts refer to abstract ideas intended mainly as functional solutions to the clients' performance problems without regard to the physical response. Convertibility is a programmatic concept, a folding door is a corresponding design concept. Problem Seeking introduces twenty-four programmatic concepts that can be used in projects.

Needs

Few clients have enough money to do all the things they want to do. According to Problem Seeking the client and architect must agree on a quality level of construction and on a definite space program as funds allow.

State the problem

The designer and programmer must detail the most salient statements regarding the problem, the kind of statements that will shape the building. Typically they cover the functional program, the site, the budget and the implications of time. The problem statements must be clear, in the designer's own words so there is no doubt that he understands.

Levels of complexity

In Problem Seeking, programming projects and their characteristics are divided into levels, ascending from less to more complex.

First level

- architect organizes the information received
- tests the simple economic feasibility of the project
- decision making is centralized in the client owner

Second level

- architect leads the client through the decision-making process
- architect takes the leadership to develop the program, provides information through interviewing, statistical analysis
- specialists are needed when making decisions with complex organizational requirements. The professional has experience in the social and political awareness to communicate with the complex client organization
- client is final authority in decision making, client might be a multi-headed group in which the owner is not necessarily the user

- user groups might be conflicting

Third level

- the analysis includes a survey of existing operational and functional plans dealing with management activities
- management of the programming team becomes critical
- timing of decisions important
- programming needs large, highly specialized practice of multi-company joint venture organizations
- one important characteristic of programming at this level is total leadership by the architect to develop the program without the involvement of the client organization
- high level decisions tend to be autocratic, whether by corporation presidents or governmental executives

1.2.3 Problems with Workplace Planning in Project Definition

1.2.3.1 Designer's Point of View vs. Operations Point of View

Problem Seeking's (Pena et al. 1987) point of view, as an architectural project definition model, is a program for an architect, the designer.

- "The problem statements must be clear, in the designer's own words"
- "Goals are important to the designer, he will not find inspiration in a list"
- "Programming is related to schematic design"
- "Programmer should know enough of the client's needs, conditions and ideas that will influence the design of the building".

Problem Seeking's classification of data collection (thirty-six categories + one hundred-thirty cell index of key words) in most cases covers most of the issues dealt with project definition. Problem Seeking guides how questionnaires must be organized to collect all the information required.

Today workplace planning is considered also (and mainly) from the standpoint of the organization's idea, it's strategy and operations.

- "align workplace strategies with business strategies and work practice to add value. Use the workplace making process to improve business practices and culture" (Joroff 2001).
- "conceiving the workplace as a strategic element in the enterprise requires a shift in how we view the workplace itself. The workplace as a strategic element of the organization is more than a physical container for work. It depends upon the internal compatibility of spatial, organizational, financial and technological arrangements" (Horgen & Joroff & Porter & Schön).
- "in the modern world the organization as whole is challenged to rethink it's central mission, assumptions, and strategies, then the spaces within which

the organization operates and the manner in which those spaces are created are equally subject to challenge" (Horgen & Joroff & Porter & Schön)

Not enough effort is put in by strategic and operational managers to lead to adequate commitment in today's project definition. The biggest mistakes in building projects are currently as follows (Huovila & Tiula 1992):

- Setting of the goals for the operations to be located in the building is rarely thoroughly carried out, sometimes not at all;
- Operations are not usually considered in the spatial need specifications;
- Site specifications are usually done without taking into account the operative spatial needs.

1.2.3.2 Decision Making and Commitment

If workplace planning is integrated into business strategy and operations, it is dependent on the client's decision making concerning strategy and operations. Such decisions are connected to a complex social system.

How does Problem Seeking guide a programmer to support the client's decision making?

- programmer must separate fact from fiction
- programmer must find out what is true
- programmer must tell the difference between established fact and mere opinion
- programmer must evaluate opinions and test their validity
- programming is the process of distinguishing between wants and needs
- generally, he who has responsibility for the outcome has the authority to make decisions. Programmer must interview him and then insist on his approval of the program.

How does Problem Seeking define decision making in different levels of project complexity?

- in the first level decisions are made by one person
- in the second level specialists are needed to deal with complex organizational requirements
- in the third level complexity is avoided by the total leadership of the architect and autocratic decision making.

Problem Seeking requires a very experienced and skilful programmer who knows the facts and can relate them to the client and thus distinguish wants from needs. When dealing with complex social systems and decision making

concerning strategy and operations, it is not possible. When referring to complex systems in problems of planning, architect Rittel uses the term ”wicked problem” (Rittel & Webber 1972).

- There is no definitive formulation of a wicked problem. Whilst solving the problem it becomes clear that the problem’s nature is different from that initially understood. When the solution is almost ready, the problem requires extensive redefinition.
- Wicked problems have no stopping rule. If it proves impossible to clearly define a problem, it will also prove difficult to know when it has been solved. It could be improved or the matter could be viewed differently. The process ends when money, time or the interest of the client ends.
- Solutions to wicked problem are not true-or-false, but good-or-bad.
- There is no immediate and no ultimate test of a solution to a wicked problem.
- …

The solutions are not true-or-false but good-or-bad. It is not that the workplace planner knows the facts because instead of facts there are numerous viewpoints. The planner must lead the client in the decision making process that leads to clear commitment, not optimal or best, but good and acceptable for business and operations.

Problem seeking doesn’t introduce concepts for decision making, rather it suggests what decisions should be made. Problem Seeking programming lacks methods of decision support or uses methods that are far too simple.

Cygnaeus high school, a test case in this research, was already programmed in the “traditional way”. But the investment in workplaces was not done. The city just stopped the project and did not give any feedback regarding the development. The programmer points out that although he can analyze needs in a logical context, the projects will seldom be actualized based on that program (Whelton 2004). Participants tend to require further investigation and extra programming (no stopping rule). It is difficult to create a common goal between strategic and operational managers.

Higgin and Jessop emphasized in 1965: “Sufficient thought and time does not seem to be given to ensuring, either as a design team brief or during the designing process, that all who must contribute understand the common objective similarly and fully” (Higgin and Jessop 1965). Coles found that the most significant causes of design problems are poor briefing and communication, inadequacies in the technical knowledge of designers and a lack of confidence in preplanning for design work (Coles 1990). In Lindkvist’s

study (Lindkvist 1996) a group of Swedish construction professionals were asked about problems in the early phases of projects. The five most important problems found are all related to client decision making, rather than to other parties or methods of working.

In the corporate real estate sector a new balance is being sought between central management and those individuals in part responsible; the trend is to move decision making to the customer interface (Horgen & Joroff & Porter & Schön 1999). Workplace management requires effective interaction between company management and the users of the space. The building industry lacks a procedure by which user operations and business strategy are converted into a project program for a building project and how this decision making is supported.

It is worth considering construction, real estate business and production theories together in cross-disciplinary research.

1.3 The Aim of the Research

The aim of this research is to create a steering model for workplace planning decision making. Spatial resource requirements can be planned on the basis of the organization's strategic and operational needs, and by using operational measurement units as initial values. The steering model will enable dialogue between strategic and operational bodies of a organization. It will produce new information and new viewpoints which when reviewed will assist the company in strategic workplace planning and project definition. The steering model will support common understanding and commitment of strategic and operational bodies of a organization to common goals.

1.4 Limits of the Research

In this research the real estate sector's commercial asset value perspective has not been considered. Such aspects are, for example, the commercial value of the building or site, appreciation in commercial value over time, balance sheet of the building etc.

The strategic goals of companies themselves are not within the limits of this research. If a procedure has an effect on strategic decision-making, it has been interpreted in this research that the procedure facilitates strategic workplace management. If a procedure effects strategic decision-making, it has been noted in the practical case-research.

The research does not consider the management of spatial resources from the

viewpoint of steering the design and sketch design economy. These viewpoints are, for example, the building's form, connections between spaces, costs of different draft alternatives or alternative material choices.

2 HYPOTHESIS

From the viewpoint of operative management, needs for spatial resources arise from the time management planning of the operational environment and the geometric requirements. From the strategic management perspective, the needs for spatial resources arise from those operations that management has chosen to realize the company’s strategic aims. It is possible to map the spatial resource needs and to categorize them in accordance with the above mentioned factors.

Studying the need for spatial resources from the perspectives of the company operative management and of company strategic management simultaneously, builds up a collective group process. It generates new information in relation to the operational environment. This information influences strategic workplace management. The information influences also, as feedback, strategic and operational decision making.

3 THE SYSTEMIZATION OF THIS RESEARCH

Workplace management has been researched by:

- Analyzing workplace planning as a problem
- Analyzing workplace planning through conceptions of production
- Analyzing workplace planning through conceptions of complexity
- Constructing the Theory of Workplace Planning
- Defining the steering model for workplace planning
- Developing the Workplace Planning Procedure to provide a representation in the steering model
- Testing the steering model in a case study

3.1 Analyzing Workplace Planning as a Problem

Workplace planning activity has been identified as a social process. This social system is perceived as complex in behavior. Organization of this complex system is perceived to occur through networks of communications, conversations and dialogues among system agents (stakeholders).

Problem definition is described in section 4.

3.2 Analyzing Workplace Planning through Conceptions of Production

Programming concepts identify often workplace in relation to design. For instance Problem Seeking's (Pena et al. 1987) point of view, as an architectural project definition model, is a program for an architect, the designer.

In the corporate real estate business (CRE), workplace planning is treated as a function of the operational process; use of space is integrated into core business operations, production.

Workplace planning has been studied through concepts of production and thus workplace planning is shown to be part of the production process. Historical analysis reveals that three different conceptualizations of production have been used in practice and conceptually advanced in the 20th century (Koskela, 2000).

- In the first conceptualization, production is viewed as a transformation of inputs to outputs.

- The second conceptualization views production as a flow, where, in addition to transformation, there are waiting, inspection and moving stages.
- The third conceptualization views production as a means for the fulfillment of the customer needs.

3.3 Analyzing Workplace Planning through Conceptions of Complexity

Workplace planning deals with social systems which are complex by nature. The evolution of complex systems cannot be precisely managed through linear steps, optimizing strategies work well only when operating in precisely known environments (Simon 1996). But by studying complex system management theories, possibilities can be found that direct evolution to possible or acceptable areas.

After World War II complexity has often been associated e.g. with “holism”, “feedback”, “cybernetics and general systems”, “chaos”, “adaptive goal-oriented systems” and “cellular automata” (Simon 1996).

Cybernetics is the study of complex systems, especially adaptive goal oriented systems; human organizations, systems in nature and machines. It is a combination of servomechanism (feedback control systems) theory and information theory. Cybernetics has proved to be especially useful over a wide range of applications when steering complex systems. Therefore that theory has been chosen to be basis of the steering system of workplace planning. Principles of cybernetics are described in section 6.

The workplace planning procedure is a mathematical model that provides a representation of the organization’s present volition. A model is never the “real truth”, but a practical approximation that may elicit practical new information. This model is based on cybernetic modeling principles.

The model traces the results of actual decisions. The Information handling is based on activity based cost management structure.

Modeling and activity based cost management are described in section 7.

3.4 Constructing the Theory of Workplace Planning

The constructed Theory of Workplace Planning is built on the basis of Production Theory’s TFV combination. The Workplace Planning Theory links

workplace planning to production, not only to construction production but also to the organization's general strategy.

3.5 Defining The Steering Model of Workplace Planning

The steering model is a mode of action that systemizes the organization's decision making actions and specific methods in accordance with workplace planning theory. By following this model different types of organizations are able to manage their workplace requirements on the basis of strategic and operational information.

The steering model defines the organization workplace planning as a social process, a collaborative group interaction and dynamic learning process. The structure of cybernetic closed loop control has been chosen as the basis of the steering model.

The concept of workplace resources combines spatial, operational and economic information (i.e. space size, building cost, actions, functions, core activity, etc.). The project contains more information than any one individual can cope with. Information must be presented in an appropriate way to company management, users, property maintenance units and designers.

A cybernetic closed loop control requires fast feedback on the results of recent decisions or proposals in group processing. For that purpose a Workplace Planning procedure has been developed.

The steering model is described in section 9. The workplace planning procedure is a part of the steering model. But because it's development is a significant part of this research, it is described in more detail in section 10.

3.6 Developing the Workplace Planning Procedure

Strategic workplace management requires that decision makers identify what they are to decide upon as well as the responsibilities that go with those decisions. It is worth noting that results of decisions should be passed on as comprehensible information to the operative level (users, planners, project leaders).

In this research a procedure for quantifying space has been developed for the management of spatial resources. The workplace planning procedure determines the quantity of the space categories needed and their required area. This is dependent upon the timing of the operations allocated to the

space, time bound efficiency goals set for the space, as well as, the performance results (actions) taking place. The space categories are determined by the activities by which the company's idea can be produced (Pennanen 1999).

The workplace planning procedure is a program which produces the required space schedules, and gives the dimensions of their floor area using both strategic information about the company (core-activities, supporting activities…) and operational information from users (time used for operations and performance results). The Target Price-Procedure (Haahtela & Kiiras 2003) and the workplace planning procedure generate feed-back for decision making (the budget of the project), an instrument for strategic planning (activities and activity based accounting), as well as an instrument for operative spatial planning (utilization degree and performance results of spaces). At the end of the decision making process, usable information has been created for the users, personnel administration and designers:

- activities
- spaces including floor area
- internal operations of the space

The workplace planning procedure is described in more detail in section 10. "Workplace planning Procedure".

3.7 Case Study; Cygnaeus High school

A steering model of workplace planning has been tested in the case of Cygnaeus High School. The customer, Jyväskylä city, had done architectural programming earlier but they couldn’t start the project. Strategic and operational management had not been able to discuss problems and the extension would have been just too expensive. Jyväskylä city asked the Haahtela Workplace Planning team to use the Steering model in order to achieve mutual commitment. The case study can be found in section 11.

4 WORKPLACE PLANNING AS A PROBLEM

4.1 Definition of the Problem

The planning of the operational environment can be defined as identifying a problem and solving it. Defining a workplace environment is a social process. Social systems tend to be complex, they are self-regulating and they can adjust themselves to new conditions (Beer 1966). It is necessary to take a closer look at the concept of a problem and complexity.

4.2 Problems for which there Exists a Clear Answer

Those problems, for which a correct answer can be found, have been named, for example, deductive problems (Nicolis 1998: 15) or tame problems (Rittel H. & M. Webber 1972). The answer to a deductive problem can be deduced from given information through steps of linear regression (gather information, analyze, solve). No new or unique information is produced during the deductive process. Deductive problems can be , for example, mathematical problems (axioms and implicit, as well as explicit theorems). Furthermore, many systems limited by humans participation are deductive. For example, the accounting system of a company is deductive, as the chaotic outer world is kept outside the boundaries of the base information in the accounting system.

Sometimes solving a deductive problem can be difficult, even impossible, even if we can verify the solution as true or false. A solution can be unattainable when

1. the problem has been poorly described (Simon 1984: 317-327). The problem could be solved if variables necessary for solution were clarified. When a poorly defined problem is being solved, collecting information may lead to a clearer definition of the problem, which may bring results.
2. the system is too complex. The system is complex if it requires information which is difficult to obtain (Ruelle 1991). It is difficult to make a weather prediction a month in advance because there are so many variables; the movement of air particles in different areas and in different air layers**,** their directions, differences in temperature, pressure differences, the shape of the earth …
3. the system is chaotic. The variables have an effect on each other. A minute change in one variable can throw the equilibrium out of balance. (Lorenz 1963). The classic example of this is the flutter of a butterfly's wings, that can, weeks later, cause a storm on the other side of the world.

4.3 Problems that do not have a Clear Answer

In the previous example, predicting weather on a long-term basis is difficult, even impossible. However, if rain has been forecast for Monday a month from now, and it then rains, we can congratulate the forecaster on his accuracy. If the problem is to define the best ever movie made, the discussion could go on for hundreds of years (Citizen Kane??).

There may be several correct solutions to inductive problems (Nicolis 1998:15). Not all the information needed for the solution can be found in the given information. The system is self-organizing, and produces new information and states during the process. Old information is not always recorded and some knowledge disappears forever. In inductive problems the answer is not right or wrong, but deemed good or poor.

When referring to inductive systems in problems of planning, Rittel uses the term ”wicked problem” (Rittel & Webber 1972). The problem is wicked, if it follows these ten commandments:

1. There is no definitive formulation of a wicked problem. Whilst solving the problem it becomes clear that the problem’s nature is different from that initially understood. When the solution is almost ready, the problem requires extensive redefinition (compared with the inductive problem which produces new information and new states).
2. Wicked problems have no stopping rule. If it proves impossible to clearly define a problem, it will also prove difficult to know when it has been solved. It could be improved or the matter could be viewed differently. The process ends when money, time or the interest of the client ends.
3. Solutions to wicked problem are not true-or-false, but good-or-bad.
4. There is no immediate and no ultimate test of a solution to a wicked problem.
5. Every solution to the wicked problem is “one-shot-operation”; because there is no opportunity to learn by trial-and-error, every attempt counts significantly.
6. Wicked problems do not have an enumerable (or an exhaustively describable) set of potential solutions, nor is there well-described set of permissible operations that may be incorporated into the plan.
7. Every wicked problem is essentially unique.
8. Every wicked problem can be considered to be a symptom of another problem
9. The existence of a discrepancy in representing a wicked problem can be explained in numerous ways. The choice of explanation determines the nature of the problem’s resolution.

10. The planner (designer) has no right to be wrong.

4.4 Evaluating Possible Solutions to Inductive Problems

The outcome of the inductive problem cannot be predicted in advance. The end result can later be understood and evaluated only in a historical and evolutional context (Nicolis 1998: 15). For example the difference between the workplace planning of the extremely efficient and impersonal 20th century American style office and that of the inefficient and individualistic European narrowly structured office is not necessarily logical. However, it can later be understood by studying the Tayloristic scientific work office culture of the time and the Northern European goals in the social sector, respectively (Duffy 1997). The cell office models of today can be understood in the light of modern team organization culture. There is no logical decision making chain that can be deducted in the decision to use the 21st century double glazed facade, but in the later history of architecture this can be understood in the light of attempts to make European management transparent.

The non-quantitative values of building, such as pleasantness, beauty, etc are culturally bound and evolution is essential to culture. People mirror concepts of beauty against their cultural background (their experience, reading, learning. etc.). The basis of Finns' taste in music is in accordance with western cultural heritage, interval division and chord techniques. Cultural heritage makes it difficult for a Finn to find Arabic, Chinese or Indian music beautiful, even though this music, like western music, includes its own culturally specific notions of beauty. Personal judgments of beauty are in accordance with personal inclinations and levels of education. The media (the press, television etc.) usually concentrate on those areas, where the values of individuals concur (how beauty is generally conceptualized) (Pennanen 1999).

Culture and pleasantness is a problematic combination, because cultural heritage is cumulative and changes over time. Impressionism in the arts at the end of the 19th century was for the most part considered incomprehensible by both critics and collectors, whereas currently both Monet and Renoir are widely regarded as masters. Many of the buildings currently regarded as beautiful (for example functionalistic) were once beautiful only to a small elite. On the other hand most of the buildings that are currently considered ugly, will, in the future, still be considered ugly, and we do not know the direction evolution will take. The Museum of Modern Arts in Helsinki by Steven Holl delighted many when it was finished, but at the same time many felt it ran counter to modern cultural evolution. Only time will tell if it will become part of the accepted cultural stratum (Pennanen 1999) (14.9.2003 The museum of modern arts was voted

one of the ten most remarkable buildings in Finland. It was also voted the most unattractive building. The poll was conducted by the Helsingin Sanomat newspaper).

It helps to evaluate an inductive problem if the measuring subject can be determined. If construction is concerned the client can be used. If a project manager or architect uses himself, he can succeed if he is an opinion leader or he might fail. Because the consequences of failure are often huge and paid for by the client, “the planner (designer) has no right to be wrong” (Rittel & Webber 1972). In this context architecture is rather more artistic than art (Pennanen 1999).

4.5 Workplace Planning is an Inductive Problem and a Complex System

The operating environment of a company is realized by buying, renting, constructing or renovating a building to better suit that company’s needs. These processes involve an endless amount of decisions. These cannot generally be made deductively from earlier decisions or from the current situation. The decisions may vary widely. The need for change by the user organization cannot be used to forecast the final requirements for space, size of building, form, materials, systems, details, costs etc. The operating environments chosen by two different organizations having the same needs are not likely to resemble each other, solutions will be good or bad, not right or wrong. Workplace Planning is an inductive problem. The chaotic birth process of the built environment allows for the setting of goals, but does not allow for the prediction of the end result at the initiation phase (Pennanen 1999).

Workplace planning is also a complex system. Workplace planning gets information from social organizations and does work for social organizations. Organizations are exceedingly complex systems (Simon 1996).

Inductivity and complexity can be avoided, ”tamed”, by standardization through central management, commonly acceptable ways of living, going to school, work, etc. This was done in the construction of Northern European apartments and schools. (Pennanen 1999). In today’s society it is difficult to set generally acceptable norms. In the current cultural environment, individuals and communities desire to be independent, and to create their own sets of values; government departments have become business enterprises, schools set their own curriculums, etc. (Pennanen 1999).

That Workplace Planning is an inductive and complex problem does not mean that one should be concerned about it. In creative human functions and in the development of human culture, chaos is important in the formation of new

viewpoints. Thought without chaos can be used for classifying, but not creating the environment. (Nicolis 1998).

5 CONCEPTIONS OF PRODUCTION

5.1 General

Programming concepts often identify workplaces in relation to design. For instance Problem Seeking (Pena et al. 1987), as an architectural project definition model, is a program for an architect, the designer.

- “The problem statements must be clear, in the designer’s own words”
- “Goals are important to the designer, he will not find inspiration in a list”
- …

In the corporate real estate business, workplace planning is treated as a function of the operational process; use of space is integrated into core business operations. Workplace planning allocates resources in relation to the working environment, its users and organization’s strategy (Horgen & Joroff & Porter & Schön). The driver of allocation is value for operations or value for strategy.

The concept of value has been studied in production theories. Production theories aim to improve the production process and the value of the product (working environment) to the customer (Koskela 2000). The following workplace planning is studied through concepts of production.

5.2 Production theory

Historical analysis reveals that three different conceptualizations of production have been used in practice and conceptually advanced in the 20th century (Koskela, 2000).

- In the first conceptualization, production is viewed as a transformation of inputs to outputs.
- The second conceptualization views production as a flow, where, in addition to transformation, there are waiting, inspection and moving stages.
- The third conceptualization views production as a means for the fulfillment of the customer needs.

5.3 The Transformation Concept

A production process can be viewed as an input-output system. There is a set of resources which we call inputs. A transformation process operates on this set and releases it in a modified form which we call outputs (Starr 1966). The transformation concept follows such principles as:

- Transformation process (operations) can be decomposed into

subprocesses, which are also transformation processes.

- Managing whole production is managing those operations.
- The cost of total process can be managed by managing the cost of each subprocess.
- The value of output is associated with the value (or costs) of inputs to that process (Koskela 2000).

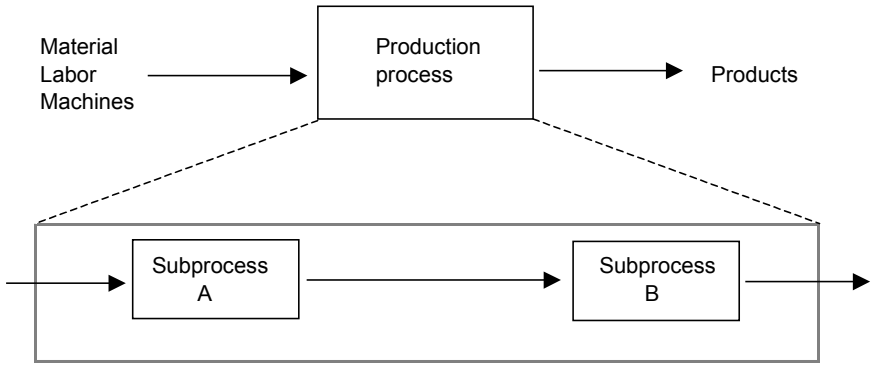


Fig. 1. The view of a production process as a transformation process

5.4 The Flow Concept

Just-in-time (JIT) movement critisizes the transformation concept. There is another dimension of production that is not captured by the transformation model, namely, what is happening between transformations (Shingo 1988). If transformation is considered as a value adding operation, there are also non-value-adding activities, such as moving resources, waiting before transformation and inspection after transformation. In the flow concept time is considered as one the inputs of the production. Production is linked to spatial and temporal flow.

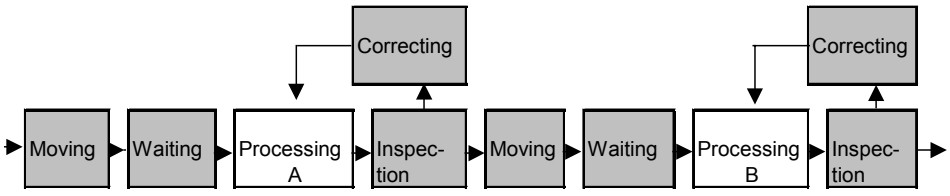


Fig. 2. Production process as a flow process. The shaded boxes represent non-value-adding activities, in contrast to value-adding activities (Koskela 2000)

Non-value-adding activities have also been considered as waste from the point of view of value-adding transformation. Production can be improved by reducing waste. Waste can be classified as flow of material or work of men (Ohno 1988):

- waste of overproduction
- waste of correction
- waste of material movement
- waste of processing
- waste of inventory
- waste of waiting
- waste of motion.

What causes waste? There seem to be three root causes (Koskela 2000).

1. The structure of the production system. The waste exists by design in hierarchical organizations; tasks are divided into subtasks and between different specialists, and so inspecting, moving and waiting increases. The waste is determined at the time of design and is thus tackled in advance
2. The way production is controlled. The waste associated with control is tackled during production.
3. The inherent nature of production. There is variability in all natural and human systems. Machines break down, accidents happen, things don't always go as planned. The waste can be dealt with after production.

The means of reducing waste are (Koskela 2000):

1. Reduce the lead time
   E.g. JIT system. One-piece lot, low capacity machines, transportation distances in lay-out, faster delivery to the customer…
2. Reduce variability
   If it is not possible to reduce variability, the following has to be accepted: long lead times, wasted capacity, lost output (Hopp & Spearman 1996). Reduction of variability within the flow process must be considered as an intrinsic goal. Variability is the universal enemy (Schonberger 1986).
3. Simplify
   Complexity increases waste. Complex systems are less reliable than simple systems. Simplification can be understood as a reduction in the number of components, steps or variables in production.
4. Increase flexibility
5. Increase transparency
   Transparency means a separation of the network of information and the hierarchical structure of order giving (Greif 1991). The goal is to substitute self-control for formal control and related information

gathering.

5.5 The Value Generation Concept

The concept of value generation focuses on the interaction between a customer and a supplier. It is not the transformation itself that is valuable, but the fact that the output corresponds to the requirements, wishes, etc., of the customer (Koskela 2000). The wishes should be condensed into a specification of the product or the customer should communicate directly with all design and production parties who make decisions relevant to him (Karlsson et al. 1998). The value generation concept has also been used as an internal analysis of production; the next transformation is considered as a customer of the present transformation.

There are five principles which cover the cycle of value generation. They are illustrated in Figure 3.

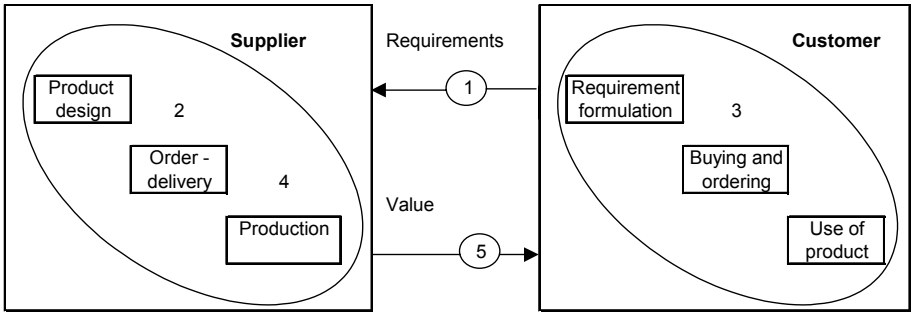


Figure 3. Principles related to the value generation concept (Koskela 2000). 1. Requirement capture. 2. Requirement flow-down. 3. Comprehensiveness of requirements. 4. Capability of production subsystems. 5. Measurement of value.

Requirement capture
Ensure that all customer requirements have been captured. The Kano model of customer satisfaction has become popular (Bergman & Klefsjö 1994). Needs and requirements can be separated into basic needs, expected needs and existing requirements. The basic needs are so obvious that the customer might not describe them even if asked. On the other hand, the customer can usually not even imagine existing requirements. When asked, the customer will usually discuss expected needs.

Requirement flow-down

Ensure that relevant customer requirements are available in all phases of production.

Comprehensive requirements
Ensure that customer requirements have a bearing on all deliverables for all roles of the customer.

Capability of the production system
Ensure the capability of the production system to produce products as required

Measurement of value
Ensure by measurements that value is generated for the customer.

5.6 Integration of the Concepts, Transformation-flow-value (TFV) Theory of Production

In his study Koskela comes to this conclusion (Koskela 2000): In production management the three concepts of production should be integrated into TFV production theory. The theories are not competing but rather complementary. As a first step towards integration, we can conceptualize production simultaneously from these three views. However, minimizing cost from the T concept's point of view might lead to lower value from the V concept's point of view etc.; the integration calls for better understanding and research of interactions between the views.

5.7 The Identification of Valuable Requirements

5.7.1 Complexity Management

Drucker argues that the value of the product can be determined only in reference to the customer. "The result of business is a satisfied customer" (Drucker 1989). He proposed a conceptualization of production that incorporates the customer. The principles of value generation can be easiest understood and studied when producing a physical object whose characteristics are known in advance. We know what it is like and we seek the fastest and cheapest way to achieve all the required quality specifications. Value is reduced if there are differences between required quality and the actual quality.

Workplace planning is linked to a complex social system. The outcome of workplace planning is the working environment strategy defined for the organization. In the initial stage of workplace planning in a multi-user organization the customer is divided into many departments all having an

operative responsibility linked to the organization's strategy. The amount of information in a organization may be so huge that no individual in strategic management or in operational management can handle everything, rather they concentrate on their responsibilities, on marketing, product design, machine maintenance, catering, accounting, managing, educating etc. These departments compete for the same resources. In the initial stage of workplace planning the outcome is not known, nor is there any quality specification against which success can be measured in a deterministic way. Instead, there are a lot of specifications and wishes, many of them in contradiction to each other and, when combined, they are generally in serious competition for the resources available. In current value generation concepts the incorporation of the customer is input-data exchange (the customer gives the requirements to the supplier) and result verification (the customer verifies that the product fulfills the requirements). As far as complex social systems are concerned, valuable requirements identification and complexity management must both be added to the current value generation concept as a part of production.

How exactly do requirements control production? There are two extreme possibilities (Koskela 2000). The first is that the needs and wishes of a customer are condensed into a specification of the product, and the specification controls the value generation. The second possibility is that the customer communicates directly with all value generation processes and production parties who make decisions relevant to him, either on his initiative or on their initiative (Karlsson et al 1998). Actually, in the first possibility, something has happened before. The client has already identified the valuable requirements and condensed them into a specification. This identification is in a black box in current value generation concepts. In the second possibility the value identification is still in a black box, alhough it is more closely linked to production.

There is much uncertainty and many iterations in design (Koskela 2000). There may be also much uncertainty and many iterations in the valuable requirements identification. If we combine iterations of valuable requirements identification with the iterations of the design, the amount of iterations would expand enormously. Complexity is unnecessary if an enormous amount of complex variables that are orthogonal (not having interaction with each other) are combined.

Complexity management can be simplified if we observe internal customer relationships in production. The rest of the production can be considered as a customer of the valuable requirements identification process. The next internal customer would be design. In design, the project requirements are translated

into a design solution. In production, this solution is realized. Vague requirements of the stakeholders harm design (and production). Design (and production) require the elimination of uncertainty regarding stakeholders' requirements.

Workplace planning (the identification of valuable requirements in the construction industry) does not aim for an optimum because an optimum does not exist in a complex system. It aims for a "good" solution. There are numerous working environment solutions that can be considered acceptable. What is the criteria that differentiates the chosen solution from the bad ones and from the other good ones? It is the *commitment* of the participants to something achieved. The product of value identification process for the rest of production is the stakeholders commitment.

When defining the hierarchy of project objectives Robert Youker underlined that the commitment of stakeholders to the common objectives and understanding of the project's goals are critical to project success. If this is not achieved, the result is confusing and conflicting as stakeholders gradually discover differences in their interpretations of the project's objectives (Youker 1998).

Indeed, stakeholders' commitment to the common values and requirements is an absolute necessity in all production to enable value generation. Thus it is a crucial part of the production.

5.7.2 Value generation concept and commitment

In a complex social organization there are many participants with many values. The different values may all be "right" but when combined cause disturbance to production. Is there a framework in which the stakeholders commitment to common values in a specific production case can be achieved? The purpose of the organization is determined by the organization's strategy. The identification of valuable requirements must be done in the context of the organization's strategy.

Shewhart presented value generation with the customer-supplier relationship (Shewhart 1931). Many production tasks, e.g. design, may be done by the organization under the direct control of the customer (the customer organization itself or the consultant). The valuable requirements identification process is also a part of production, and is mainly carried out by the customer organization. In a complex environment the value generation concept must incorporate the customer directly in the production decision making process in

order to manage (and reduce) complexity, as shown in fig. 4. The customer communicates with the production parties and commits to production requirements by evaluating potential values to his strategy.

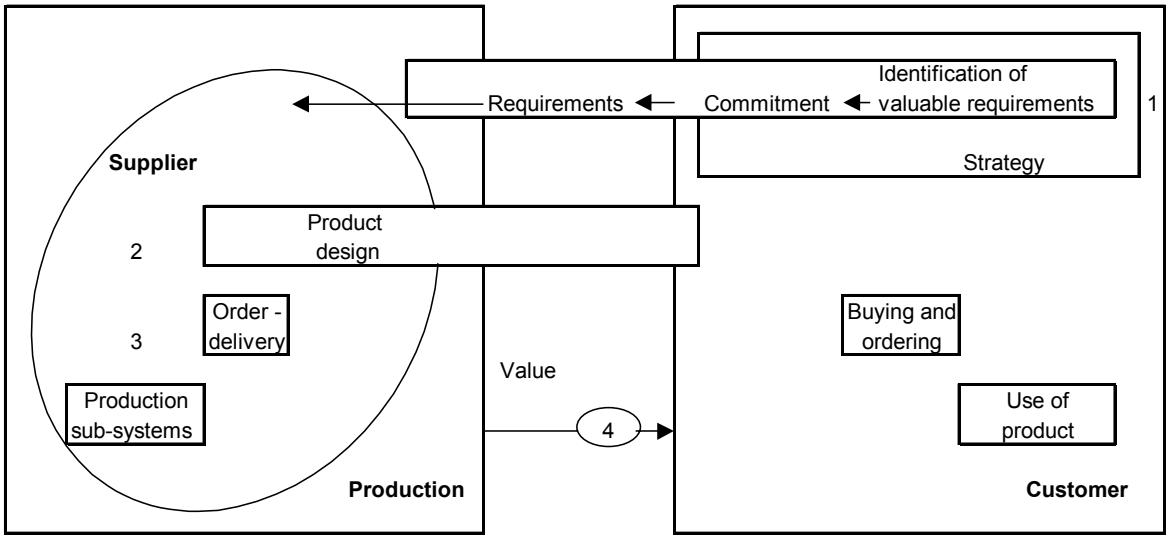


Figure 4. Principles related to the value generation concept in complex environment. 1. Identification of valuable requirements. 2. Requirement flow-down. 3. Capability of production subsystems. 4. Measurement of value.

The identification of valuable requirements in the context of strategy may require complexity management. Complexity has been studied in chapter 6 and a steering model for the identification of valuable requirements in construction industry is presented in chapter 9.

Commitment and it's role in a project has been studied in connection with software process improvement. Based on empirical findings, it was shown that while objective features, costs and benefits dominate in the project initiation phase, their role tends to reduce in later stages due to an inability of the effort to produce meaningful results, even if these are explicitly sought. This phenomenon gives rise to a need for enhancing the role of commitment and its social and psychological drivers at the operational level. If this is not achieved, software process improvement activities are likely to cease to exist (Abrahamsson 2002).

From the workplace planner's point of view mutual commitment is a necessity and can be considered as a product, too. Planner, as well as client, know that it is possible to generate several acceptable environments but they will not be adopted without commitment.

5.8 Commitment

5.8.1 Concepts of Commitment

Commitment has been studied through dynamic games and from an individual's point of view. An individual interacting dynamically with others can often benefit from the opportunity to credibly bind himself to certain actions (Caruana & Einav 2003). Commitment has also been studied through organizational behavior, from the viewpoint of individuals as members of an organization. Because workplace planning demands commitment to common goals, organizational behavior is more interesting.

An actor, e.g. operative or strategic manager, might be committed to a project or organization in four forms or archetypes (Abrahamsson 2002):

1. Affective commitment
   Affective commitment refers to an actor's attachment to, identification with, and involvement within the respective entity (an organization, a project…) (Meyer & Allen 1991).
2. Continuance commitment
   Continuance commitment refers to an awareness of the costs associated with leaving or abandoning the respective entity (e.g. aborting a project) (Meyer & Allen 1991). These costs may be both financial and non-financial. If an organization, e.g., has a reward structure in which a manager's performance is linked to the success of a project, it can be said that the primary commitment driver of the manager is continuance commitment.
3. Normative commitment
   Normative commitment reflects a feeling of obligation to continue membership with the entity in question (e.g. a project) (Meyer & Allen 1991). As normative commitment may only last until the "debt" is regarded as paid, it is to be subject to be lost later on.
4. Instrumental commitment
   Instrumental commitment refers to a form of involvement for specific, extrinsic rewards (O'Reilly & Chatman 1996). E.g. a manager is not committed to the project goals because of personal recognition, but due to a desire to derive benefit and avoid punishment. Some researchers (Meyer & Allen 1997) have criticized that instrumental commitment is the of antithesis of commitment.

In relation to commitment and cooperation in an organization there are two other psychological concepts that should be mentioned; altruism and reciprocity. Altruism matters in the workplace insofar as people's actions at work depend on a feeling of benevolence towards co-workers. People might

do actions because they enjoy the benefits this gives to others they care of. Reciprocity means that people reward kind actions of others and punish unkind ones. People do actions because they would feel it would be unfair to others to do otherwise (Rotemberg 2002).

5.8.2 Commitment Process

An individuals commitment changes continually. This change in commitment has been studied in a Information Systems project (Newman & Sabherwal 1996). As one of the results of the study a dynamic model of commitment has been constructed, including five processes (Figure 5). Three of them are decision making processes (A,C,E) and two are intervening events (B,D). Newman and Sabherwal explain that the project started with A and was followed by the loop B>C>D>E>B. This loop was traversed three times. The conflicts may be e.g. conflicts between commitments or organizational changes.

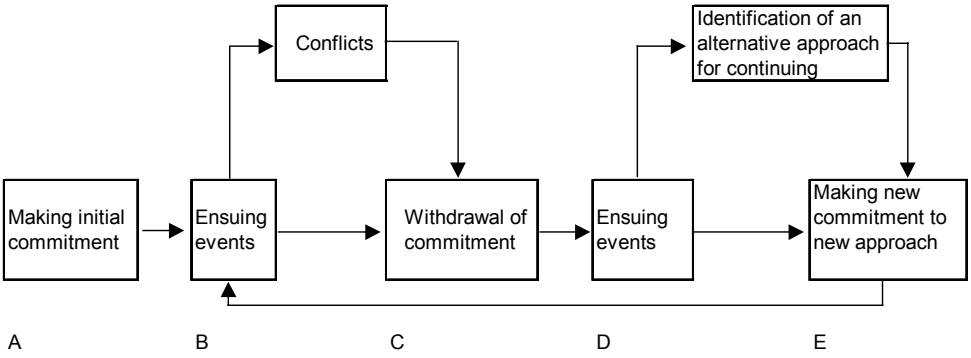


Figure 5. The dynamic commitment model (Newman & Sabherwal 1996)

According to the study, the individual stakeholders are committed to their various different goals during the initial stage, so there may be conflicts between goals, personnel etc. To find a new target for mutual commitment, new approaches must be identified. Achieving a final commitment of an organization is an iterative process of commitments, withdrawals and new approaches.

5.8.3 Commitment and Workplace Planning

What archetypes of commitment are interesting to a workplace planner:

- Workplace planning seeks common goals in a complex social system. If

instrumental commitment is used, the goal should be determined first (tamed complexity) and a reward should be set for achieving that goal. If a wide commitment to workplace planning is required, instrumental commitment seems not to be the workplace planner's tool.

- To be effective, normative commitment has to be built into an organization before workplace planning starts through the socialization process. A newcomer to an organization learns what is valued and what is expected of a novice by that organization. In turn, the newcomer is expected to behave in an acceptable manner (Wiener 1982). If normative commitment does not exist, a workplace planner can not create it within a project.
- Previous investments, financial or mental, affect continuance commitment. This kind of commitment is possible in the architectural design phase when participants, after having done much work and invested in designers, commit to achieved solution. Workplace planning is usually done at a very early stage. Continuance commitment in the beginning is rare but, of course, it is possible at the end of the process.
- Affective commitment may be created or strengthened in the beginning and during the workplace planning. It is worth concentrating on variables affecting affective commitment.

Work experiences are seen to play the most important role in the development of affective commitment toward a commitment target. Following variables have been found to be important: (Meyer & Allen 1997):

- Job challenge
- Degree of autonomy
- Variety of skills used
- Participation in decision making
- Fairness of organizational policies and treatment
- Personal fulfillment
- Personal importance
- Personal competence
- Decentralization
- Transparency in information given

In general, employees that have a strong confidence in their abilities and achievements (personal competence) tend to develop a stronger sense of affective commitment.

Altruism seems to be often endogenous, it can not be created for better cooperation during workplace planning. Instead, reciprocity is related to an individuals belief in, or knowledge of another's actions. Reciprocity seems to

play a clear role in the feelings that employees have towards their employers (Rotemberg 2002), e.g. in strategic management and operational management relations. There is evidence that workers who feel betrayed or treated unfairly by their employer take actions that cause their employer harm; this can also be termed poor morale (Rotemberg 2002).

5.8.4 Conclusions

Concepts of commitment and reciprocity give tools to strengthen cooperation and achieve commitment in workplace planning. The steering model of workplace planning must:

- support and stimulate strategic and operative mangers to participate in decision making
- decentralize the decision making to the levels where responsibilities are met
- be transparent in terms of information handling
- treat all information equitably, regardless of its origin

These characteristics must be constructed in an iterative steering model because previously committed stakeholders need an opportunity to commit to common goals.

5.9 Workplace Planning from the Production Theory's Point of View

The physical outcome of workplace planning is spatial needs; the workplaces and requirements set on the workplaces. The abstract outcome is the commitment; it is valuable to invest in these workplaces (valuable requirements for workplace production). The commitment is achieved by the workplace planning process. Production theory can be studied in relation to the workplace planning process or in relation to the identification of workplace needs and formation of commitment.

5.9.1 The Transformation View

5.9.1.1 Identification of Workplace Needs in Relation to the Transformation Concept

Since commitment to the operations that require spatial resources is the product of workplace planning, then the transformations (operations) inside those spaces are important to workplace planning. The size of the space is due to the transformations; if a client does mental work in his space, he needs a 11 m2 room. If he also has 6 people negotiations in the room he needs a 20 m2 room.

5.9.1.2 Workplace Planning Process as Transformation

Workplace planning is a transformation. Wishes, wants, needs and available resources are transferred to a possible environment solution and by iterations, dialogues, the creation new valuable information, the omission of information that appears to be unnecessary the commitment to a working environment for strategy and operations will be fixed.

Workplace planning can be divided into tasks such as:

- gathering information
- interviewing
- determining activities needed
- modeling spaces and performances for activities
- cost estimation

Workplace planning processes should be made more efficient by developing more efficient tools for tasks; methods of interviewing, applications for modeling spaces and performances and applications for cost estimation. However, commitment is not just the sum of these tasks. It is by no means certain that just by minimizing the cost of those tasks that good value and lower costs in workplace planning will be achieved. Decision making and commitment is not easily described as a transformation and thus more research will be required.

5.9.2 The Flow View

5.9.2.1 Identification of Workplace Needs in Relation to the Flow View Concept

Since commitment to the operations that need spatial resources is the product of workplace planning then the flow of transformations (operations) inside those spaces is important to workplace planning. The number of the spaces is due to the flow of transformations inside those spaces; if the members of a 100 people marketing group spend on average 3 hours/ working day at their own workstations, they need 100 workstations with less than 40 % temporal utilization. If hot desks are used (an incoming person chooses the first free workstation), the utilization degree can be raised to 75 %, so only 50 workstations will be needed to support all the activities.

5.9.2.2 Workplace Planning Process as Flow

Workplace planning is information handling, and the information flows through the transformation, waiting, moving, inspection and correction stages. According to the flow theory, only the transformation stage is value adding, the

others are waste and should be eliminated.

Information flow can be improved by increasing transparency. Transparency means a separation of the network of information and hierarchical structure of order giving (Greif 1991). The goal is therefore to substitute self-control for formal control. Workplace planning is decision making among strategic and operational managers. If the product of workplace planning is commitment then transparency has been shown to be urgently needed.

The time and effort needed for all the necessary transfer of information can be reduced through a team approach. In a team, much information can be transferred informally and orally through vertical and horizontal divisions. It also means that the team is empowered to make decisions that would otherwise be made at higher hierarchical layers (Koskela 2000).

The uncertainty in workplace planning arises from the variability in values of people in the organization. We don't have a specification for workplace planning but a wide set of specifications. Variability is named " the universal enemy" (Schonberger 1986). Also rework and iterations due to uncertainty are waste in the flow concept (Koskela 2000) and should be removed by removing complexity, variables, steps, and by standardization etc.

There is complexity in workplace planning as described in Chapter 4. Commitment in workplace planning is a state of a social system and social systems are complex by nature. Because the values of the people and their responsibilities in the organization differ, people emphasize the importance of activities in different ways. It produces several iterations and proposals that must be together again evaluated against the organization's strategy. After all, an organization commits to one solution and the other solutions can later found out to be waste. But since commitment is considered to be the product too, it can not be achieved without the other proposals and their information.

Standardization and fewer variables would mean fewer opinions, a narrower range of values from various people and more autocratic decisions. It would quickly lead to a workplace solution but not to commitment. It would lead to iterations and waste in designing and contracting. If we operate in a complex environment, we have to admit that not all the complexity is the "universal enemy". Then a certain variability in the process is urgently needed. The workplace planning process can be made faster by adopting the flow concept. But workplace planning's relation to complexity must be researched more and determined in the context of theories of complexity.

5.9.3 Workplace Planning as Value Generation

5.9.3.1 New formulation

In the value generation model the focus is on control of the transformation and flow, namely control for the customer's sake. Value generation according to Koskela is a process where value for the customer is created through fulfillment of his requirements (Koskela 2000). In workplace planning there are many specifications and wishes, a number of them in contradiction with each other and they are all often, if combined, in serious contradiction with the resources available. The production is not the fulfillment of all the requirements. The product of workplace planning is the organization's commitment of what needs and activities will require spatial investment to serve the strategy of the organization in a beneficial way. For workplace planning value generation should be determined in another way.

Workplace planning deals with a set of competing specifications and the customer must be involved directly in production decision making as it is presented in chapter 5.7.2.

For workplace planning value generation can be formulated as follows:

> *a process where valuable requirements for production are determined through observing and evaluating the values of stakeholders against the customer's strategy.*

5.9.3.2 Complexity Management in Workplace Planning and Design

If we compare workplace planning to design, there are similarities in uncertainty and in non-repetitiveness (project type). Both design and production are based in known definitions and success can be measured against these definitions. Uncertainty in design is related to the fact that there are numerous solutions to the definition. In workplace planning uncertainty is more complex. The planner knows the initial information but can not be sure if all the information is really necessary (Chapter 4). The planner can not evaluate the result based on previously set criteria, but must rely on the ongoing judgement process of the stakeholders.

A certain variability in the workplace planning process is acceptable and indeed required. However complexity is not a target, it is a phenomenon. If we combine architectural design and workplace planning, it leads to an unnecessary amount of information and complexity; one must deal with information of activities valuable to strategy, their need for spatial recourses, the shape of the building and layouts of the sketches etc. It might be asked:

could the space for an activity, that in the end proves superfluous, be located in the basement, as in this sketch or on the third floor, as in another sketch? This kind of decision making is very slow and expensive. There are numerous possible locations for a space, once it has been deemed essential to the strategy! If 100 architects are consulted, they will submit 100 proposals, many of them excellent. Sketch design doesn't create more valuable information for decision making in workplace planning. There is much uncertainty and many iterations in design (Koskela 2000). There is also much uncertainty and many iterations in workplace planning. If we combine iterations of workplace planning with the iterations of the design, the amount of iterations would expand enormously. Complexity is unnecessary if an enormous amount of complex variables that are orthogonal (not having interaction with each other) are combined.

Complexity management can be simplified if we observe internal customer relationships in production as presented in chapter 5.7.1. The rest of the construction process can be considered as a customer of the workplace planning process. The next internal customer would be design. In design, the project requirements are translated into a design solution. In production, this solution is realized. Vague requirements of the stakeholders harm design (and production). Design (and production) require the elimination of uncertainty regarding stakeholders' requirements. The product of workplace planning for the rest of construction is the stakeholders commitment.

If workplace planning is separated from architectural design, total waste of construction can be reduced and value generation can be more efficient since unnecessary complexity will be reduced (Fig. 6). In the initial stage the customer doesn't know what activities require spatial investments. The customer communicates with a production sub-system, the workplace planning process. After workplace planning and commitment have been achieved, the customer determines the value criteria for the design (spaces, performances, budget…). The potential value of the product to the customer is known but the form of the physical product is unknown.

The customer starts to communicate with another production sub-system, the design process. During design the customer commits to the physical product, the design solution. The value and the characteristics of the physical product are now known (size, shape, connections, materials, equipment, details…) but it does not yet exist.

Complexity has been reduced. As the customer communicates with the next production sub-system, the contractor, production becomes a controlling

process from the customer's point of view.

Workplace planning is rather a visual angle than a chronological stage of a construction project. Although it is mostly used in the initial stages, it can be used whenever new commitment is needed. Construction is no longer managed in a straightforward manner using steps such as define goals, design and construct. Part of production may be in the workplace planning process, part in design and part in construction. Today it is often the case that the customer simply changes the goals, which he of course has the right to do at any stage. If commitment to the same goals must be changed e.g. in the design phase, it is simple matter of doing some workplace planning concerning those goals and then to continue designing (see example in chapter 9.13).

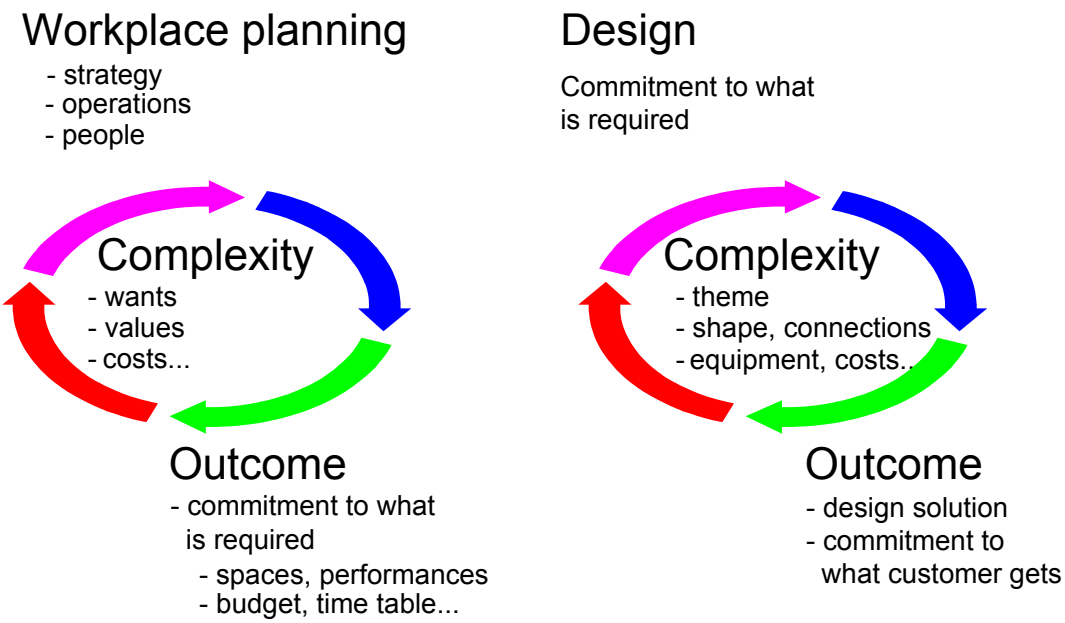


Figure 6. Unnecessary complexity can be reduced by separating the workplace planning process from the design process.

Researcher's observations in practice

Previous statements may be contradicted. Many architects state that it is possible to create needs by architectural design. It is possible to design something fantastic, and a customer will commit to that solution in spite of it's irrelevance to the customers strategy. This is a rare but distinct possibility. However, this new information can still be added to the workplace planning steering model. That supposed need for something fantastic has then to be evaluated among the

other values. Workplace planning can also be carried out during design.

5.9.4 Workplace Planning and “Soft Values”

Many requirements affecting job satisfaction are measurable and thus they can be determined using workplace planning. For instance a comfortable internal climate can be achieved by controlling temperature e.g. within +- 2 degrees and comfortable lighting can be achieved by controlling the color and luminance of lamps.

However, there are soft values (e.g. beauty) that can not be controlled in a quantitative way. How does workplace planning deal with soft values?. To answer that question we have to find out what factors correlate to architectural quality. Architect Ilkka Niukkanen has studied the correlation of architectural quality and building costs (Niukkanen 1980). The population of the study was design & build competitions in Helsinki City residential building production. The competitors competed with architectural design solutions and price tenders. The architectural quality (external beauty, internal comfort, habitability) was analyzed by a delphi-group and value analyze matrix. The result of the study can be seen in Figure 7.

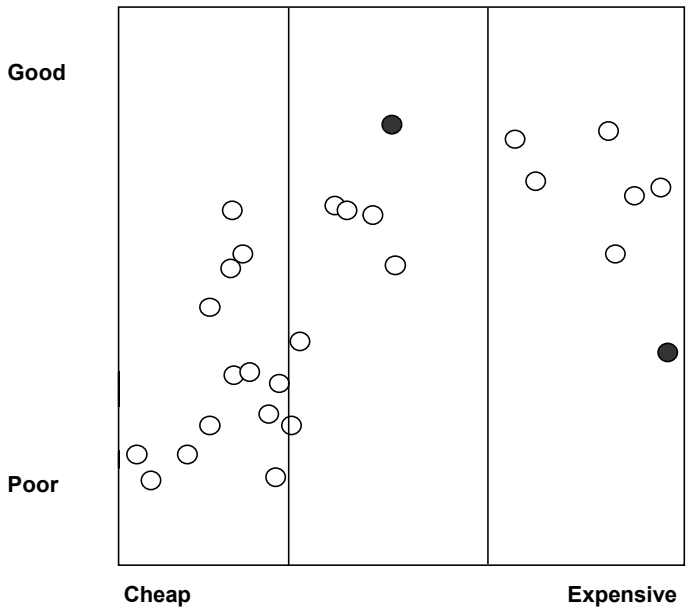


Figure 7. Architectural quality and building costs in Helsinki City residential building production (Niukkanen 1980).

If we aim at a minimum price, it might lead to poor quality. But very soon when

moving to average price production, the correlation between quality and costs disappears. In Niukkanen's study the most expensive design solution was quite poor in terms of quality and the best quality was achieved with a reasonable price (of course, high price did not prevent good quality). When moving from minimum to reasonable costs the quality can not be assured by allocating more resources to production, indeed, this may just as well lead to a poor quality solution as a high quality one. It seems that architectural quality is linked to creativity and artistry of the design group in interpreting our culture and it's changes rather than to money (see chapter 4.4). If we operate with minimum cost, the alternative design solutions are limited to a few, and creativity will also be limited. Solutions below minimum cost do not any more fit the functional requirements. If in workplace planning financial targets are set in a reasonable area in relation to quantitative requirements there will be an enormous amount of possible design solutions. In that area good architectural quality is possible. This will be realized by design, designers and steering of the design.

5.10 Conclusion

The product of workplace planning is the commitment of stakeholders to a chosen working environment, as well as the chosen environment itself.

Workplace planning is strongly linked with value generation for the customer, indeed it actually generates value. Commitment after workplace planning is a declaration that: among all the values, these are the ones deemed to be valuable to our strategy. Workplace planning must concentrate on stakeholders' values, value management, on stakeholders' collaboration and interaction and on organization's strategy. Workplace planning incorporates the customer in production decision making.

The value generation concept's impact on the flow concept is that some degree of complexity has to be accepted and that some degree of variability is needed in the process. The impact on the transformation concept is that workplace planning is also a decision making task. It is so closely linked to value generation that its costs can not simply be minimized.

In the flow concept time is considered as one of the inputs of production. Production is linked to spatial and temporal flow. It has been shown in practice that there is much temporal waste in customers' workplaces, they are not well occupied. If workplace planning can reduce that waste, it would be a significant benefit for customers.

The TFV concept is usable in workplace planning. More beneficial results can

be achieved if needs identification through TFV concept are studied; spatial expenses (investment + maintenance costs) vary from 5 to 30 % of the total financial resources of offices and schools (Kuntien kiinteistötalouden kehittämisohjelma, yhteenvetoraportti 1997).

The TFV concept is usable when studying the workplace planning process, too. Tasks can be done more efficiently by improving methods. There is a lot of waste in present practices that should be removed. However, to define unnecessary waste from necessary variability and iterations for commitment in complex social systems, managing complexity in parallel with reducing complexity should be added to production theory.

6 CONCEPTIONS OF COMPLEXITY

Complex theories claim, in contrary to production theories, that complex systems are not simply the sum of their parts. Whereas details of components can often be ignored while studying their interactions in the whole system, the short-run behavior of the individual subsystems can often be described in detail while ignoring the interactions among subsystems. In economics we can study the demand for iron ore, pig iron, sheet steel etc. But studying these subsystems a central bank can not predict fluctuations and control interest rates. The evolution of self-organizing systems cannot be precisely managed through linear steps, optimizing strategies work well only when operating in precisely known environments (Simon 1996). But by studying complex system management theories, possibilities can be found that direct evolution to possible or acceptable areas.

After World War II complexity has often been associated e.g. with “holism”, “feedback”, “cybernetics and general systems”, “chaos”, “adaptive goal-oriented systems” and “cellular automata” (Simon 1996).

6.1 Complexity and Chaos

The theory of chaos is linked to solid mathematics and deterministic dynamic systems. The variables in the system have an effect on each other. Even a infinitesimally small change in one variable can throw the equilibrium out of balance. (Lorenz 1963). Thus, although the system is deterministic, its detailed behavior over time is unpredictable.

In classical nonlinear theory a system might come to a stable equilibrium, or it might oscillate permanently within a limit cycle, like the orbit of a planet. A chaotic system, however, might also enter a region of its state space, the strange attractor, in which it would remain permanently. Within the strange attractor motion would not cease, nor would it be predictable, but although deterministic, would appear to be random (Ruelle 1991).

Chaos theory describes the characteristics of deterministic systems. Workplace planning is an inductive problem that is not deterministic as described in Chapter 4, although it has also chaotic features.

6.2 Complexity and Cybernetics

The production of steel sheets of equal thickness in the mid 1950's can be used as an simple example of cybernetics (de Latil 1956). Half a dozen variables were known to affect the thickness of the metal sheets, such as the speed of the roller drum, temperature of the steel and the amount of compression. Engineers studied the effects of each variable separately and from these studies ideal conditions were synchronized, where according to the laws of physics the desired product was manufactured. This, however, did not produce steel sheets of consistent quality. The system to be adjusted was complex, it changed the initial values (temperature), and knowing their exact values was difficult. The system was chaotic; a reduction in speed lowered the temperature, a reduction in temperature raised compression, an increase in pressure reduced speed and raised temperature, etc. Everything influenced everything else, even a small change in initial values led to a large change in the final result.

Adapting cybernetic control to the problem, engineers added to the system an electronic feedback loop, a sensor which measured the thickness of the newly produced steel plate and sent the information back to the regulator, a servo-motor, which adjusted only the pressure of the roller drum. Adjustment of the thickness of the plates was successful. Having the wrong speed or temperature was no longer important. By changing one variable the whole variable group could indirectly be controlled. The regulator did not need to know all the reasons; it just measured and corrected (de Latil 1956).

After World War II the concept of what Norbert Wiener named cybernetics emerged, a combination of servomechanism (feedback control systems) theory and information theory. Information theory explains organized complexity in terms of the reduction of entropy that is achieved when systems absorb energy (information) from external sources and convert it into a pattern or structure. Feedback control shows how a system can work towards goals and adapt to a changing environment. What is required is the ability to recognize the goal, to detect differences between the current situation and the goal, and actions that can reduce such differences (Simon 1996).

Cybernetics is the study of complex systems, especially adaptive goal oriented systems; human organizations, systems in nature and machines. Cybernetic systems have many heterogeneous interacting components. Systems are adaptive and self-regulating, they tend to evolve and grow in an opportunistic manner, rather than be designed and planned in an optimal manner. Systems are constructive, in that as they tend to increase in size and

complexity, they become historically bound to previous states when simultaneously developing new traits (Principia Cybernetica 1992). Cybernetic management searches for acceptable paths rather than a simple optimum; the word cybernetics is derived from Greek word meaning steersman.

6.2.1 Control

The concept of control is the cornerstone of cybernetics. Control is the operation mode of a control system which includes two subsystems; the controller (C) and the controlled (S). In Fig. 8 the controlled is disturbed D. A perfect controller would keep the controlled outcome E in the required state in spite of disturbance. The controller needs information about disturbance to plan its actions and the connections are:

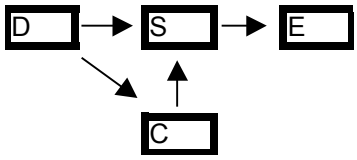


Fig. 8. A perfect control

Perfect control is possible if information flow is sufficient and the relation between D and S is known. It may be that the controller moves at a higher speed than the controlled, and plans its actions before the controlled starts to respond to the disturbance (Ashby 1956). A chief-cook can double the raw-material procurement when he anticipates that business will double tomorrow. The goal, a meal for each, will be achieved.

Sometimes, however, the C's action cannot be communicated to S before its outcome on E. In that case, the best that can be done is that imperfect regulation should be as good as possible in the circumstances. Information from D to C can be forced to take a longer route so that C is affected only by the variation in E. The connections form an "error-controlled servomechanism" or "closed loop regulation" with feedback. The fundamental property of error-controlled control is that it cannot be "perfect" (Ashby 1956). The diagram is (Fig. 9):

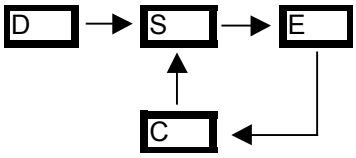


Fig. 9 A Closed loop control

This form is of the greatest importance and widest applicability when controlling complex systems.. When is closed loop regulation and feedback needed? It is needed if it is impossible to predict D's affect on S and it's outcome E and thus it is impossible to plan regulation based on the information of D (Ashby 1956). It happens if

- Information about D is inadequate or not communicated fast enough. It would be hard to regulate a meeting-room's internal temperature based on tomorrow's weather report and the anticipated amount of people in the meeting. The weather report may prove inaccurate and some people may not show up. It's easier to let disturbance happen, measure it's affect on E (too hot) and to regulate it with that information (more cool air).
- The controlled (S) is too complex. We can not predict its outcome even if we know the disturbance. Steel sheet production in the beginning of this chapter is an example of this. Another example would be steering the economy of a nation. The central bank knows the variations in imports, exports, levels of production, investments etc. It does not, however, know exactly how the variables affect the economy. It must observe the new states of the nation and then decide, for example, on interest rate policy.

6.2.2 Controller

A controller can be formed so that in the controller there is a representation of the controlled system and an agent which is responsible for its actions (Principia Cybernetica 1996). Representation is an object whose states can be identified with perceptions. The actions of the agent depend on the flow of information from the representation. The action of S (or E) on C is limited, it can change only it's representation in C, not in the rest of the system. The action of S is filtered through the representation, its effect on C cannot be greater than that permitted. Thus the control relation is asymmetric, C controls S but S does not control C (Fig. 10).

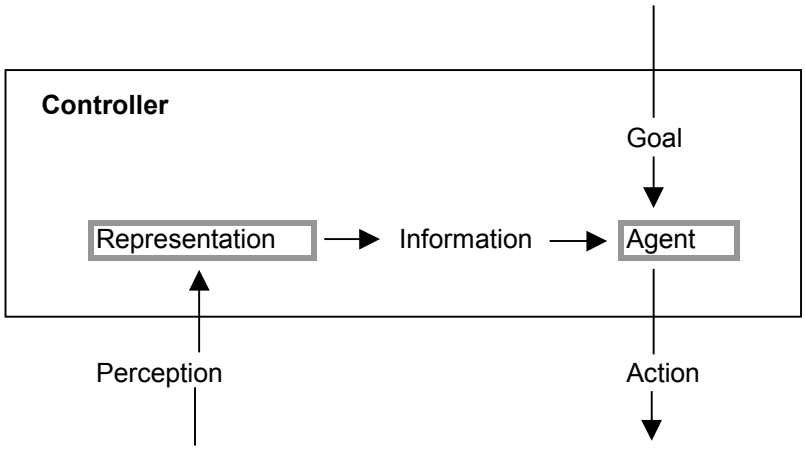


Fig. 10. Controller

The controller includes one more object which influences the agent: the goal. The goal can be simple or a complicated set of goals (Ashby 1956). The agent compares the current representation with the goal and takes actions which tend to minimize the difference between them. This is known as purposeful behavior (Principia Cybernetica 1996).

6.2.3 Learning

Cybernetics also concerns the principle of learning (Beer 1966). By studying the process to be steered, a model (representation) which describes reality as closely as needed is formed. The regulator (agent), which steers the process, uses the model. The influence of the regulator's command on the achievement of the goal is measured and further used to fine-tune the model. In this way the regulator will give better results in the future. The feedback loop, the regulator and the regulator's program together form the steering system.

6.2.4 Feedback

The behavior of the steering system is purposeful**,** it can resist and over ride the effects of outside disturbance and keep to its goals. So that the original aims can be achieved, the steering system needs a feedback loop, dampers (negative) and amplifiers (positive) (Principia Cybernetica 1997). Only positive feedback leads to divergent behavior, indefinite expansion and a snowball effect. Too much complexity needs to be damped, so that the number of alternative states is kept manageable. Damping must be planned; it cannot be done randomly.

6.2.5 Requisite Variety

If there is big variance in the controlled – disturbance –pair (S-D), it can, due to the internal positive feedback, lead to destruction of the system. This can be avoided only if there is large variance in the controller; only variety in C can force down the variety due to the D (Ashby 1956). If a species survival is a goal and there is a big variance in its environment in time and space, there should be a big variance in it's gene-pattern. This is how nature works. Only a control-system which contains variation can produce alternatives in a creative way to keep to goals in spite of disturbance.

6.2.6 Information flow

If a closed loop control is designed, information flow from the present state (E) to the controller must be adequate and fast enough. If the flow is inadequate the controller can not plan the actions. If it is too slow, the controlled will go on creating new states before the controller can act. If there are restrictions in the flow of information it will be difficult, or even impossible, to maintain control (Ashby 1956).

6.3 Conclusions

Workplace planning is an inductive system and linked to a complex system. Chaos theories are solid mathematics and linked to deterministic dynamic systems and deductive problems rather than to inductive systems.

Cybernetic feedback control shows how an inductive, adaptive system can work towards goals and adapt to a changing environment. Cybernetics has proved to be useful over a wide range of applications. In chapter 9 the characteristics of Cybernetics are studied as a basis for Workplace Planning management.

7 MATHEMATICAL MODELS IN COMPLEX SYSTEMS

7.1 Black Box

The Workplace Planning Procedure (Chapter 10) is an adaptation of a mathematical Operations Research model. It is used as a representation in the steering model of workplace planning.

Operations Research is an attempt to control complexity through modeling reality, by using a model that simulates reality by using a limited number of variables and with limited complexity. This type of mathematical model requires quantification of variables (Hillier & Lieberman 1980).

Usually in the laboratory model all variables, apart from two are fixed. Then, one is varied and the effects on the other are observed. In complex systems this is not possible, variables cannot be fixed, because they have an effect on one another and the meaning of variables in the system changes over time. Variables in a complex system are for example, product quality, costs of production, the characteristics of the products of competitors, salaries, employee motivation, the set of values of purchasers, e.g. The continuous calculation work needed for all variables is laborious and paralyses company management. Usually the model is built by creating a steering system that brings a stable equilibrium instead of the simple maximum (Beer 1966). It is good, but not the optimum that is sought.

In workplace planning it is not important that the model produces an absolutely correct value. For the conclusion it is usually sufficient that the model produces the magnitude of difference between different alternatives, the relative correlation and a value, close to the truth (Hillier & Lieberman 1980). If the model produces a result different from the measured observation, it does not mean that the model has given the wrong result. The reason is either one pertaining to variations in reality (usually a coincidence) or the roughness of the model (intentional). In order that the information handled by company management does not become too large or complex, a black box can be added to the model. For example, if the cost prediction for the event given by the model is 27 000 € and the measured observation of the same event is 36 000 €, the black box states a value of 75 %. In other words, the model calculated three quarters of the effects of the event and the rest has been caused by an unknown mechanism in the black box. The black box measures the difference between an analytical model and empirical data. If the relations measured by the black box accumulate and behave consistently, the model

can be adjusted with the black box without knowing the mechanisms included in it (Beer, S. 1966). This type of adjustment requires the continuous maintenance of the black box.

7.2 Activity Based Management

The closed loop control requires a representation of the controlled system in the controller (see Section 6). The controlled system in workplace planning is the organization that needs a working environment. The outcome is spaces that are used by one or more operational departments. To understand the links between power to make decisions and responsibilities in workplace planning the spaces must be treated as resources demanded by operational departments.

In his dissertation Heikki Piirainen suggests Activity Based Management and Activity Based Accounting as tools for bringing visions, services and activities of an organization into line in a construction project (Piirainen 1996).

In activity based accounting resources are initially directed towards activities and in the end towards a product or products. An operatively obtained method can be used the other way around, the quantity of products or functions are varied and thus, the variations in the use of resources can be observed.

The product is the goal of the function. The products use activities and therefore, resources (Brimson 1991). The activities are either core activities or support activities. Core activities are those which immediately produce results. Support activities support core activities. Without support activities functional process breaks or becomes more difficult, particulary on a longer time span (Kärri & Kangas 1994). Analogical in the organizational models are line management and staff management.

Activity based cost management is based on activities that link organizational spending on resources to the products and services produced (Atkinson & Banker & Kaplan & Young 2001). A company producing color-pens is presented as an example of ABC management. The company had used traditional accounting. Direct costs (material costs, direct labor…) were directed to each product. Indirect costs (machinery, quality control, purchasing, maintenance, room rent…) were allocated to products in relation to their production volume. The outcome was:

	Blue	Black	Red	Purple
Selling volume	50 000	40 000	9 000	1 000
Unit selling price	$4,50	$4,50	$4,65	$4,95
Material costs +				
Direct labor	$117 000	$93 600	$21600	$2 490
Overhead	$78 000	$62 400	$14 040	$1 560
Return of sales	13,6%	13,3%	14,8%	18,2%

Management steered strategy based on that information but was not satisfied with results. They decided to use ABC management that traced indirect expenses to individual products, services and customers. They concentrated on indirect costs; indirect labor, fringe benefits, computer systems, machinery, maintenance and energy.

7.2.1 Tracing Costs to Activities

Indirect costs are first traced to activities (fig. 11)

- a controller discovered that 50 % of the company's indirect labor was involved in scheduling orders, purchasing and first-item inspection, when the process was changed to a new-colored pen. The controller aggregated all these tasks into an activity and named it "handle production runs".
- Another 40 % of indirect labor actually performed the physical changeover from one color pen to another, this activity was labeled "perform setups".
- most of the company's computer time was used to schedule production runs and to order and pay for the materials required in each production run. 80 % of computer resources were involved with the activity "handle production runs"
- the rest of computer time was used to keep records on products. This activity was labeled "support products".
- energy was used to…

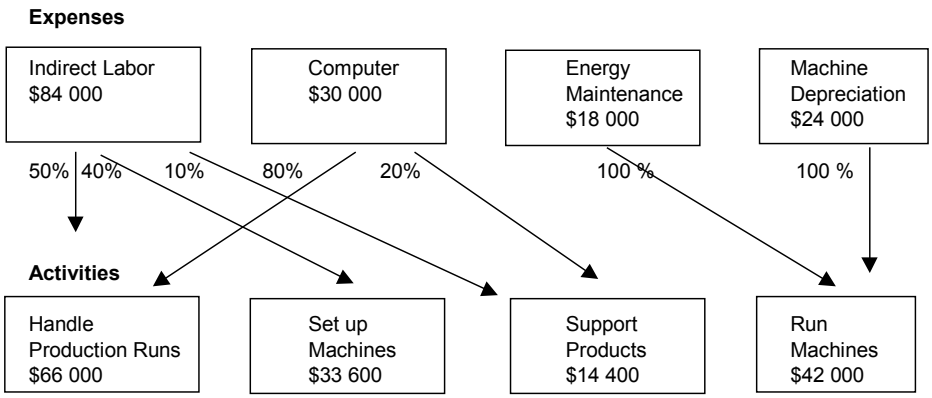


Fig. 11. Mapping Resource Expenses to Activities

7.2.2 Tracing Costs from Activities to Products

The next step is to understand why the activities were being performed. Therefore, the activity expenses needed to be related in some way to the demands for the activities by the individual products.

Activity cost drivers identify the linkage between activities and cost objects, such as products, services and customers. They serve as quantitative measures of the output of activities. The following activity cost drivers were identified for the activities:

Activity	**Activity cost driver**
Handle production runs	Production runs
Set up machines	Setup hours
Support products	Number of products
Run machines	Machine hours

Activity cost driver rates were calculated then by dividing the activity expense by the total quantity of the activity cost driver.

	Handle Prod Runs	Set up Machines	Support Products	Run Machines
Activity Expense	$66 000	$33 600	$14 400	$42 000
Activity Cost Driver Quantity	150	526	4	10 000
Activity Cost Driver Rate	$440 per run	$63,88 per hour	3 600 per product	4,20 per hour

Management investigated how much activities each product used. The final calculations were done using activity cost drivers.

	Blue	Black	Red	Purple
Handle prod.runs	50	50	38	12
Set up machines	200	50	228	48
Support products	1	1	1	1
Run machines	5000	4000	900	100

An the final report was:

	Blue	Black	Red	Purple
Selling volume	50 000	40 000	9 000	1 000
Unit selling price	$4,50	$4,50	$4,65	$4,95
Material costs + Direct labor	$117 000	$93 600	$21600	$2 490
Handl. Prod. Runs	$22 000	$22 000	$16 720	$5 280
Set up machines	$12 776	$3 194	$14 565	$3 066
Support products	$3 600	$3 600	$3 600	$3 600
Run machines	$21 000	$16 800	$3 780	$420
Return of sales	21,6%	22,7%	-44,0%	-200,1%

So, the marketing department might try to get higher a price to compensate for the higher costs of red and purple pens or operative management might try to develop production to reduce the use of activities (resources) used in red and purple pens.

8 THE THEORY OF WORKPLACE PLANNING

Practical theory is based on concepts, principles and methodologies (Koskela 2000). The concept provides an answer to the question: What is this? The principles provide the causality that makes prediction possible and so answers the question: How?. Based on principles, it is possible to create methods, tools etc. for controlling the phenomena covered by theory (Koskela 2000).

The workplace planning theory links workplace planning to production, not only to construction production but also to the organization's general strategy.

8.1.1 The Concept

The purpose of the organization is determined by the organization's strategy. The strategy is realized by the operations.

A spatial investment in an operation competes for the same resources as the other investments in the operations. Workplace planning brings spatial investments and values concerning the spaces into line with the other factors of production.

Workplace planning is a process where valuable requirements for workplace production are determined through observing and evaluating the values of stakeholders against the organization's strategy. The product of workplace planning is the stakeholders commitment to the spatial needs of the operations.

The size of a space is dictated by the operations (transformations) taking place within that space and these operations can be decomposed to sub-processes which are also operations.

Spaces are the scene of a temporal flow of operations and non-use time. The number of spaces is due to the temporal utilization of the spaces.

8.1.2 The Principles

Spatial investments in operations that are not needed for the organization's strategy are not value-adding and therefore are waste.

Spaces are the scene of a temporal flow of operations and non-use time. The operations are value adding whereas the non-use time is not value adding to the strategy. Non-value adding time is waste and should be reduced or removed. Temporal waste can be removed by following these principles:

- Combine diverse activities into the same working environment.
- Plan spaces to be flexible enough to support diverse activities.
- Combine similar activities of separate operational departments to same environment

If waste of spaces unneeded for operations and waste of non-use-time can be reduced, more resources would be available for other investments, spatial or non-spatial.

The value of a spatial investment in an operation can not be predicted based on the initial information, decision making is linked to complex economic-technical-social systems. Commitment to common values can be achieved via iterative steering concepts of complex social systems (Fig 12).

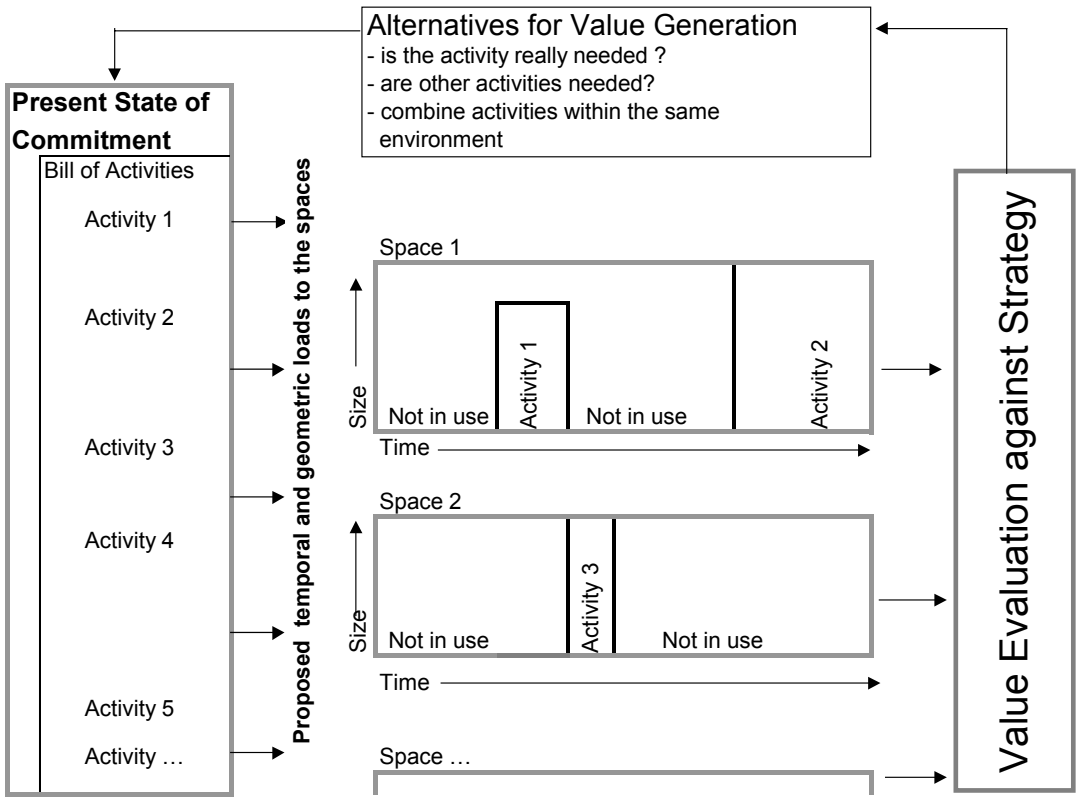


Fig. 12. Workplaces as a transformation/ flow /value generation process.

8.1.3 The Methods

A significant product of workplace planning is commitment of the stakeholders to investment in workplaces. Decision making for commitment requires fast feedback in a complex social system. Modeling methods are needed to show decision makers the responsibilities that are due to the proposed needs. Participants must have information on operations, spaces, sizes, their temporal utilization degrees, investment costs, life cycle costs and possibilities of combining operations within the same spaces.

To support the stakeholders' commitment process, the steering model of workplace planning must:

- support and stimulate strategic and operative managers to participate in decision making
- decentralize the decision making to the levels where responsibilities are met
- be transparent in terms of information handling
- be fair regarding equitable handling of information

The stakeholders are committed in the initial stage to their present values. These characteristics must be constructed in an iterative steering model because stakeholders need an opportunity to commit to common goals.

9 THE STEERING MODEL OF WORKPLACE PLANNING

9.1 General

The steering model is a mode of action that systemizes the organization's decision making actions, produced information and specific methods in accordance with workplace planning theory. By following this model different types of organizations are able to manage their workplace requirements on the basis of strategic and operational information.

The steering model of workplace planning might be part of a project definition and its results will then be actualized in design and construction. It may also be part of long term workplace strategy, actualized in transactions and organizational changes.

The steering model does not need information that is derived from architectural or engineering design. Workplace planning deals with strategies, operations and allocation of resources. Design deals with theme, shape, connections of functions, details and materials. Workplace planning and design use and create different information. Workplace planning asks, is it needed, what resources does it require, is it still valuable? Design asks where it will be located as part of the design theme and shape? If we combine these viewpoints and information, it might be asked: could the space for an activity, that in the end proves superfluous, be located in the basement, as in this sketch or on the third floor, as in another sketch? Both workplace planning and design are complex systems. For any functional and visual problem stated there are almost limitless amounts of alternative architectural design solutions. Design proposals do not remarkably increase the information needed in workplace planning but they might become fixed and thus prevent creativity when handling complex design problems.

9.2 The Structure of the Steering Model

Workplace planning is linked to a very complex system; sets of goals, a wide range of needs, different viewpoints of the owner and user etc. Even though in strategic workplace management there is no one correct answer, there are certain limitations on decision making that can not be exceeded. The most important points are economic and temporal limitations. The system needs a damped feedback system to keep it in balance. New viewpoints and creative ideas will be welcome if they produce new alternative solutions in an area possible to business. An individuals commitment changes continually. An

iterative dynamic system would support participants' commitment towards common goals (Newman & Sabherwal 1996). The Steering Model for Workplace Planning is an application of cybernetic closed loop control (see chapter 6 and Fig.13):

- Controlled system is the organization definition of its working environment
- Controllers representation measures systems outcome. Controller's representation consists of two sub-models:
  - Workplace Planning Procedure and
  - Target Price Method (Haahtela-Kiiras 2003)
- The cybernetic "steersman" in the controller is an organized dialogue between strategic and operative management of the organization. Dialogue is responsible for the actions.
- The dialogue is led by a human agent, a professional in project management, the steering model and the required procedures.

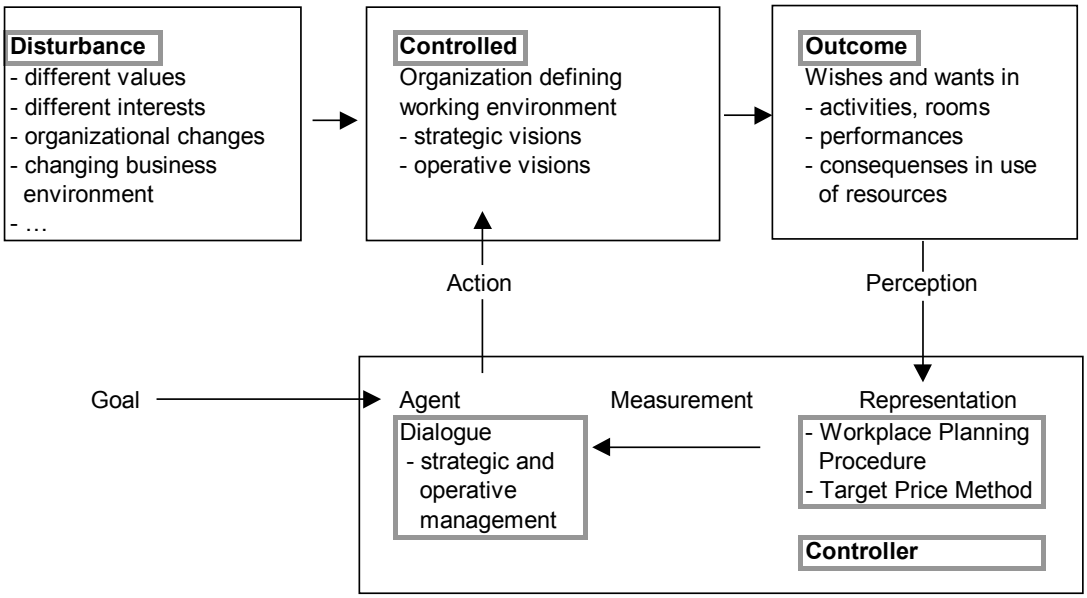


Fig. 13. Closed loop control adjusted to workplace management

9.3 Controlled System

The controlled system is the organization that is defining its spatial requirements. The complexity of information needs to be reduced as it moves up the organization hierarchy (Beer 1969). Organizations tend to localize and minimize information demands by decentralizing decisions. Matters of fact can be determined whenever the most skill and information is located to determine

them, and they can then be communicated to “collecting points” where all the facts relevant to an issue can be put together and a decision reached (Simon 1996). However, it is not reasonable to allow the production department and the marketing department of a company to make independent estimates of next year’s demand if the production department is to make the products that the marketing department is to sell. It is preferable that all the relevant departments responsible for the operations operate on the same body of assumptions even if the uncertainties might justify quite a range of different assumptions (Simon 1996).

The aim of this research is to manage spatial needs on the basis of the organization’s strategic and operational needs. Therefore the organization must be organized for workplace planning so that strategic decision makers (“common assumptions and goals”) and operative decision makers (“collecting points for decisions”) are represented and identified. They will represent the whole organization during the dialogue and value generation.

Normally strategic decision makers come from the top leadership of the organization. Operative decision makers come from the organization’s departmental management. Examples:

Education

Strategic management:
- board of the institution
- president of the institution

Operative management
- leaders of the faculties

Church

Strategic management:
- church council
- minister of the church

Operative management
- priest in charge
- leader of child work
- leader of youth work
- leader of adult work
- leader of social work

Police

Strategic management:
- public administration
- police chief

Operative management
- leader of the patrols
- leader of the investigations
- leader of the technical investigation
- leader of the …

9.4 Disturbance

Disturbance comprises everything that causes complex variation in the outcome. However, complexity is necessary for creating new viewpoints, new states and new information for testing, although it tends to push the system out of accepted balance and must therefore be managed. Disturbance is not good or bad, it is a phenomenon, a part of life and therefore part of the steering model.

There are many participants in workplace planning. Strategic leaders, operative managers, workplace professionals, project managers, architects, users, investors, contractors, regulators, neighbors among others. The multivariate bodies generally hold different values, different starting points and different perspectives on the workplace. They pursue different and often conflicting objectives and seek to protect their respective interests (Horgen & Joroff & Porter & Schön).

The business environment is constantly changing and organizations are undergoing organizational changes. Global competition, technological breakthroughs and new product demand have changed the corporate world. In response companies are resizing or reengineering their strategies. Business has become increasingly complex (Lambert & Poteete & Waltch 1995).

Disturbance is normally linked to
- different values of the stakeholders
- different interests
- organizational changes
- changing business environment

9.5 Outcome

Outcome means the decision maker's decisions concerning the workplaces, their belief in what the organization needs as a working environment. Outcome is the sum of numerous decisions and decision makers:

- wishes on the activities
- wishes on the spaces
- money needed
- time needed

9.6 Controller

The controller is built up of the dialogue between strategic and operational management and two mathematical models to create information for dialogue, namely The Workplace Planning Procedure and The Target Price Method.

9.7 Dialogue

The characteristics that individual managers bring to the workplace planning have three principal roots. First, these individuals have professional orientations that carry distinctive professional languages and values. Second, they have personal styles that determine how they set and solve problems and how they create and respond to interpersonal relationships. Third, they come from different divisions within the same organization, and they occupy specific roles and positions of authority (Horgen & Joroff & Porter & Schön). In order to balance disparate objectives and resolve conflicts of values, one must bridge across the different languages, styles and organizational roles of decision makers. One should learn to see more acutely how these factors enter into decision-making about the work environment (Horgen & Joroff & Porter & Schön).

Organizational loyalty can be labeled identification. The motivational component of identification is an attachment to group goals and a willingness to work for them even at some sacrifice of personal goals. The cognitive component of identification requires that decision making is dependent on information that is locally available to individuals (Simon 1996).

The steering model of workplace planning includes a component that promotes organizational identification by giving a forum to view alternatives from organizational goals and by unifying organizational language. This component is a transparent dialogue between strategic and operational bodies.

Dialogue is also the steersman which is responsible for the actions (the agent in chapter 6). In dialogue, strategic and operational management examine the workspace environment from their own positions. Operative management looks for functional rooms for the operations they are responsible for. Strategic management maps the activities that the business idea requires. Dialogue offers many advantages to steer the complex system:

- Rittel suggests debate as the solution to inductive problems (Rittel & Webber 1972). Methods are needed that support collective understanding, consensus and mutual decisions.
- De Bono considers the concept of solving inductive problems together with the concept of ”lateral thinking” (de Bono 1993). Lateral thinking is based on insight, which comes when the problem field is simultaneously investigated from different perspectives.
- If there is big variance in the steered system, the controller must also be able to produce variety (Ashby 1956) (chapter 6, Requisite variety). During the course of the dialogue, both parties produce new information whilst they are shaping and defining the actual problem. As strategic and operational management are called to dialogue, the variety of the controller is as big as the problem.
- According to Newman and Sabherwal the stakeholders are also committed in the initial stage, but there may be conflicts with goals, personnel etc. (Newman & Sabherwal 1996). To find a new target for mutual commitment, new approaches must be identified. Achieving final commitment of an organization is an iterative process of commitments, withdrawals and new approaches. Dialogue is a way to find new approaches and to stimulate managers to transparent decision making.

9.8 The Workplace Planning Procedure and Target Price Method

The controller consists of a representation of a controlled system. The representation is composed of two mathematical models:

- the Workplace Planning Procedure created in this research
- the Target Price Method (Haahtela-Kiiras 2003)

In the workplace planning process the client does not dictate the spaces and areas that he or she requires but describes the activities that he or she needs. The Workplace Planning Procedure supplies dimensions for the working environment and lists it as spaces required.

The Target Price Method (Haahtela-Kiiras 2003) calculates the budget based on the rooms and the requirements for those rooms. The Target Price Method is a mathematical model that creates the link between the requirements the client sets on the rooms and the possible distribution of elements + use of resources connected to running costs (energy, cleaning…). The budget can

then be addressed back to the activities by tracing paths back in the Workplace Planning Procedure. After measurement the client knows the current or desired state of the system; what kind of working environment it would be, which resources the environment demands and what activities cause them.

During the process participants develop alternative solutions, reshape the corporation's activities and working models. These changes can be added to the workplace planning model for present and future use (principle of learning, chapter 6).

The Workplace Planning Procedure is described in more detail in chapter 10.

9.9 Agent

The dialogue is led by an agent, a professional with experience of the steering model and the required procedures. The agent is aware of the goal. The agent compares the current representation with the goal and suggests actions which will minimize the differences between them. Therefore purposeful behavior by the controller is represented by an agent.

9.10 Goal

The goal is based on a client's business plan. The spatial environment must support the corporation's basic idea. Before the workplace planning process, the client and the agent describe the most important goals of the corporation (e.g. core activities required and constraints in economy and time).

9.11 Information Translations in the Dialogue

9.11.1 General

The complexity of information needs to be reduced as it is moves up the company hierarchy (Beer 1969). Company management does not need to know everything happening on the construction site or in marketing. Correspondingly, the functional environment is more complex than the company's operations. The complexity of information reduces as it travels up the company hierarchy.

The horizontally complex information of organizations should be reduced. When complex information crosses internal boundaries within the organization, it may easily become incomprehensible to those on the other side of the boundary. Information must be recorded in the language of the new organization. The translator must be sufficiently competent to handle complex

information. The new building's catering manager does not recognize the need for structural beams, nor does the building project manager usually, regrettably, care about the preparation of vegetables. (Pennanen 1999). These organizational boundaries exist between the user and company management, planners and the users, etc.

9.11.2 The Operative Management's Viewpoint

The responsibility for the realization of the company's strategic goals is given to different parts of the organization and finally to individuals. The user's viewpoint is practical; the space is the functional environment that makes operations possible. The space should facilitate functional performance, as should other specified features, (temperature control, computer connections, cleanliness of air…).

Functional measurements are important for user decision-making and for commitment. The user cannot be told that these boundaries are generally planned in these dimensions, but should be informed of what possibilities the space allows. Through functional performance results (termed actions) questions may arise such as "how do the special requirements change if:"

- 8 people instead of 4 people need to fit around the conference table?
- the secretary needs 30 meters of shelf space instead of 12 for document storage?
- if the food is served in an islet instead of distribution in a line?
- the height of a 1000 pallet warehouse is 5 meters instead of 4?
- the conference space also needs to be used for video presentations?

9.11.3 The Viewpoint of Strategic Management

Spaces and their performances are too detailed for strategic decision-makers to consider.

In activity based accounting, which is extensively used in industry, information is condensed by underlying and defining operationally critical activities and allocating variable and fixed costs to them.

In the business world efficiency is commonly measured through benchmarking, a comparison with other companies which operate in the same field. Comparing buildings to one another is largely unhelpful, because no two buildings are functionally identical. However, if the company's functional environment is divided into operative activities, comparison between them becomes possible and sensible. Dining can be compared to dining; conference activities to one another, data transfer to one another etc.

9.11.4 The Real Estate- and Building Sector's Viewpoint

The real estate sector handles space as an asset to be maintained, sold, rented, or improved. Commonly used is a catalogue where space has been classified in the desired way.

Also, in the building sector it is customary to use a catalogue of spaces, the spatial program as the preliminary information for planning.

9.11.5 The Chosen Presentation of Spatial Resources in this Research: Action, Space, and Activity

In this research three descriptive ways have been chosen to present spatial resources, all of which describe the functional environment of the company, from different viewpoints. These descriptions are performance actions, space, and activity.

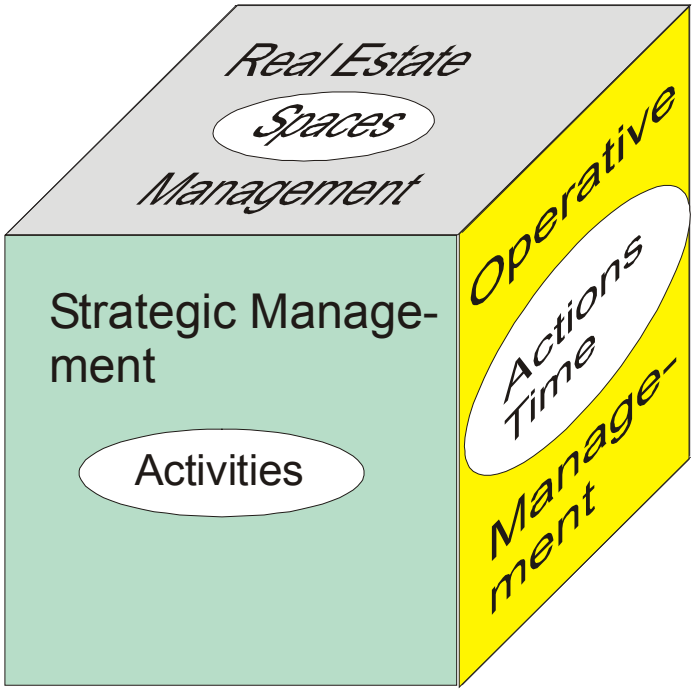


Fig. 14. Three perspectives to describe organizations workspace. Activities for strategic management, working environment enabling actions for operational users and rooms for real estate management

Real Estate Management

Spatial resources are described to real estate management as lists of spaces and their floor areas. When the spaces are classified, the system of classification follows that of the Target Price System (Haahtela & Kiiras 2003).

User

Spaces are described to the user as performance results that describe the usability of the space. Whilst traditionally users have been informed that individual room size varies between 10…17 m2, this information has not supported the user commitment process. In spatial resources management the space ”Patient bedroom” is described by referring to its potential to bring about performance results (named actions later).

Patient bedroom 10 m2	**Patient bedroom 15 m2**
- Sleeping - Storing, 2 cupboards - Guests sitting - Working at table	- sleeping, access from 3 sides - Storing, 4 cupboards - Washing hands - Guests sitting - Working at table

Table 1. Working environment defined by actions

Company Strategic Management

Spatial resources have been described as functional entities, as activities, each with it's own measurement unit. For example, a restaurant provides food and an environment for its consumption (measurement unit: number of persons), a storage activity provides storage facilities (shelf meters), an accountancy practice is responsible for internal and external accounting (number of persons), property activities are responsible for property maintenance (size of the building) etc.

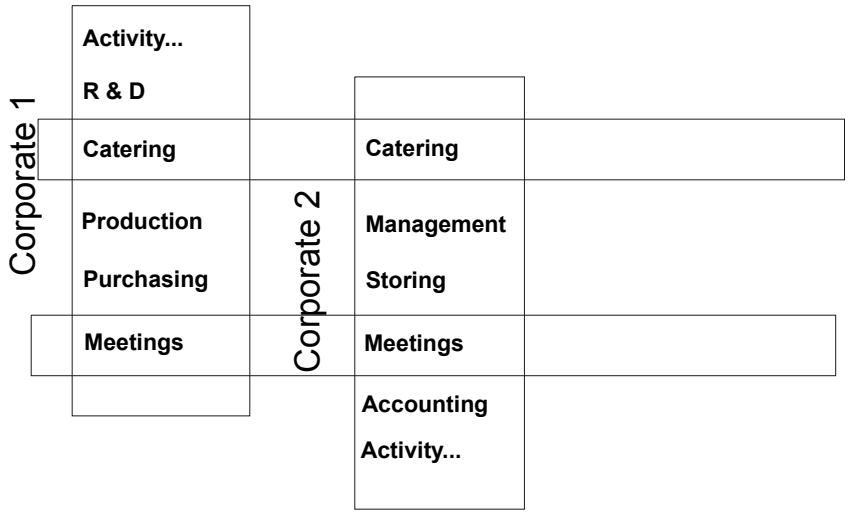


Fig. 15. Activities. Vertical and horizontal perspective

The concept of services, when used by real estate management is often limited to considering the activities not included in the core activities, which the company is ready to out-source. In this horizontal activity concept, companies aim to concentrate on core activities and the operators of out-sourced activities increase efficiency by choosing the support functions of others as their core competence.

In this presentation activities are considered vertically from a company viewpoint, in such a way, that all functions of the company are produced as activities (Fig 15). In the strategic management of spatial resources observation is made of which activities and to which degrees spaces are required in order to achieve the company business idea. Spaces will be classified together as functions of these activities, without company management having to research them. To be able to handle these activities a system of classification has been created.

9.12 The Steering Process for Workplace Planning

The workplace planning process is like orienteering on hilly ground. The participants must continually make decisions. The consequences of these decisions in regard to goals may become ambiguous. The participants run into a valley from which they can not see the direction in which they should travel. By measurement the entropy of the system is decreased, the present state is defined and so the next hill can be climbed. The direction can be seen again and a new set of decisions started. The direction is clear until, after a while, the valley is reached; and a new measurement is required.

In workplace management the lack of rapid feedback in relation to spatial and economic goals has been a serious problem. The different parties (users, planners, owners…) can progress quite far and commit themselves to goals that are unachievable. Economic feedback can come in the form of a contract offer or a production plan cost estimate, months after decisions have been made. When there are thousands of decisions, the decision makers cannot retrospectively be held responsible or made to commit to their original goals. The system has been allowed to become complex without damping. From the viewpoint of leadership, the same thing can be described as power without accountability.

9.12.1 Planning the Process

Before the workplace planning process the client must be organized. In the process the operational requirements and ideas will be evaluated against strategic goals. It is important to define, who is representing the strategic view of the company and who represents the operational views of the departments.

9.12.2 Interviews

Strategic management interview

The agent identifies the business plan, the activities with which the plan can be achieved, the drivers of the activities and the economical and temporal limitations. Some examples of business plans in case studies:

- to offer rehabilitation services for patients with spinal cord injury, traumatic brain injury, stroke and polio. Driver: will be extended to 75 patient capacity.
- to offer business-, technical- and social sciences polytechnic education for Swedish speaking people in a new campus in the Helsinki city area. Driver: 1 630 students.
- to sell PC computers, customized software and server-capacity to

business. Driver: 390 employees
- church activities in a Helsinki suburb. Driver: 35 000 people living in the suburb

Some core activities and their drivers in previous business plans:
- occupational therapy 60 patients
- speech therapy 20 patients
- accommodation (ward-type 1 or 2 person rooms) 75 patients
- general studies in technical faculty 120 students
- server maintenance 96 employees

Some supporting activities and their drivers
- administration 2 persons
- accounting and information activities ask the operational manag.
- food services 150 meals/ shift
- reference library ask the operational management
- …

Operational management interview
The agent identifies how the operations of the activities are planned to be realized. The activities are divided into sub-activities which are needed to make the activities possible. For instance, food services comprise food preparation activities and eating activities, a library comprises customer activities and material activities etc. If possible, the load of the sub-activity is determined. Some sub-activities, their drivers and their load in case studies:

	driver	load
eating activity	150 meals/ shift	45 min/ meal
acute ward studies	60 students	8 credits, 40 h/cr
reference library shelving	5000 volumes	0,025 m/volume

And finally, the desired working environment for sub-activities is identified. The working environment means the name of working area and the actions in the area:

Acute ward studies

60 % of the load	General lecturing area
	20 students workplace
	1 teachers workplace
	30 m shelves
20 % of the load	Acute ward workshop
	10 students lying on their

back
10 students sitting
100 m deep shelves

20 % of the load not in built environment

9.12.3 Current or Desired State Measurement

The workplace planning process starts by defining the initial state. The agent interviews each party separately from their own viewpoints. In this stage the agent is more interested in understanding the viewpoints than criticizing them.

The interview is recorded in the workplace planning procedure and in the target price method. The outcome of these two methods is the room schedule needed for the activities, their utilization degrees if possible, and the budget for construction and maintenance during the building's life cycle.

The workplace planning procedure and the target price method are themselves deductive and give the "right" answer with no alternatives, based upon the information the parties have given. Measurement does not describe the past nor does it give advice on the future but shows the declination to the target. After dialogue and any new decisions measurement must be re-done.

Activity	Quantity	Unit	Space (m2)	m2/ unit	Utilization (%)
Health care faculty	**495**	**Pers**			
Anatomy store	1		10	10,0	
Art teaching, 16 stud	1	Classr.	60	60,0	27 %
Physical examination	1	Classr.	133	133,0	51 %
Physiotherapy (chouchroom), 20 stud	1	Classr.	175	175,0	10 %
Clinical treatment	1	Classr.	60	60,0	24 %
Acute ward, 15 opp	1	Classr.	56	56,0	25 %
Acute w. store	1		10	10,0	
Tissue samples, 7 stud	1	Classr.	35	35,0	20 %
Polyclinic ward, 15 stud	1	Classr.	40	40,0	6 %
Children ward, 27 stud	1	Classr.	50	50,0	13 %
Surgery, 15 stud	1	Classr.	35	35,0	10 %
Maternity ward, 10 stud	1	Classr.	40	40,0	12 %
Exhibition cupboards	1		13	13,0	14 %
Central store	1	Classr.	35	35,0	
Gymnasium	1	Classr.	300	300,0	6 %
	usable area		1052	m^2	
	circulation area, delivery		140	m^2	
	circulation area, section		60	m^2	
	plantroom area		63	m^2	
	Net area		1314	m^2	

Fig. 16 Part of the Arcada Polytechnic school workplace planning outcome

9.12.4 Dialogue

Practice has shown that when groups can freely define their goals in regard to required functions, they almost always end up outside the possible area. Their desire for functions exceeds their resources to produce a matching spatial environment. The result is simply too expensive.

The project group, strategic and operative management, becomes acquainted with the initial state measurement. The workplace planning procedure and the target price method are made transparent, so that the parties may understand each other's perspectives, and so facilitate the process. Participants realize that something must be done. They start to become familiar with the entity and to the each others' wishes.

Consensus requires an understanding of the viewpoints of different parties. Empathy to other's viewpoints helps facilitate compromise. Various different important viewpoints must be integrated for steering to succeed.
The dialogue can occur in a meeting or the agent may transfer information between groups. The agent is conscious of the target and prepares the participants for the allocation.

9.12.5 Allocation

In case the measured state proves to be outside the possible area, the functional concept will need to be changed, and the direction of changes will depend on the group achieving commitment on the allocation of funds. The agent can deliver his/her suggestions, but in practice it is difficult to address from where the outstanding ideas come from. The dialogue ultimately defines what is really important and what is less important.

If a better allocation of funds is needed, the agent's proposals might be:

1. Combine activities
- can diverse activities be combined within the same working environment? Combining will mean that space will be used more efficiently leading to increased utilization
- should actions be planned in the environment more flexibly so that activities can be combined within the same environment?

2. Combine similar activities of separate operational departments
- can similar activities be combined within the same working environment? (e.g. meetings, resting…)? This will allow increased utilization of the space.

3. Is there somewhere else in the neighboring environment where the activity

can take place

- auditorium utilization is very low. Can auditorium capacity be rented elsewhere in the neighborhood ?

4. Is the activity really necessary? Compared to another?
    - Is the action/room of/for that activity really needed?
5. Are other activities needed?

An example of the Polytechnic case can be found in Fig. 16. The rooms with low utilization degrees were evaluated. Clinical treatment, polyclinic treatment and maternity treatment are taught in a similar environment, the actions (sleeping, storing…) are almost identical. The spaces used for physical examination and exercise are also similar, mainly requiring an open space. The clinical treatment environment was provided with some new actions and polyclinic and maternity teaching was combined into the clinical treatment environment. Physical examination was combined into the gymnasium. The cost reduction was 18 %. Quality was not reduced (activities were not removed and Clinical treatment utilization was still less than 50 %).

9.12.6 Next Steps

Workplace planning is a complex and self-organizing process. Groups continue making decisions and soon new measurements and a new dialogue to steer the process will be required. In case studies the whole process has lasted from 3 months to 1 year until architectural design has been started.

9.13 Workplace Planning in Relation of other Production Operations of Construction

Workplace planning, when part of project definition, is normally seen as a preceding phase of the other building phases, i.e. the design and construction phases. Empiric experiments have shown that workplace planning is rather a visual angle than a chronological stage of a construction project. Although it is mostly used in the initial stages, it can be used anytime new commitment is needed. Construction is no longer managed in a straightforward manner using steps such as define goals, design and construct or by target costing steps such as define goals, budget goals, design to budget. Today it is often the case that the customer simply changes the goals, which he of course has the right to do at any stage, as long as the customer organization accepts the consequences of the new decision. If commitment to the same goals must be changed e.g. in the design phase, it is simple matter of doing some workplace planning concerning those goals and then to continue designing.

A practical example in a Arcada case study

Arcada is a Swedish speaking education institution in Finland. It serves the needs of the Swedish speaking community particularly in the Helsinki metropolitan area. The Arcada Strategic body was a board made up of a collection of notable persons from the Helsinki business community. This was a voluntary board that developed the interests of this particular community. This body was tasked with developing a central campus for the Arcada Polytechnic. Other stakeholders associated with the body included:

- The Swedish literature institution;
- The Swedish education friends; and
- The Swedish Cultural association.

The main strategy for Arcada was to create a centralized campus area. Currently their real estate stock is distributed over Helsinki. A centralized campus was seen to create a cohesive identity for the Swedish education community.

Haahtela workplace planning started in late 2000. Ari Pennanen interviewed the operative sectors that included:

- Technical teaching.
- Health sector and social work (nurses, therapy, social work) – This sector was considered important to preserve Swedish culture among aging citizens.
- Business education.

The health sector had activities that needed the support of a therapy pool. In workplace planning it became apparent that the inclusion of a therapy pool would not be possible due to financial constraints (very expensive and low utilization degree). Architectural and engineering design was started.

When design had, after one year, reached the production design phase (drawings for procurement), the workplace planning group found a private sector body willing to cooperate with Arcada. The Folkhälsan institute announced that they were ready to invest in therapy pool activities in Arcada if they could use the pool in their service purposes (e.g. they are ready to commit to a long term rent agreement). This group provides senior citizen services e.g. living communities and services. This business development was a group discussion with the Arcada network. Ari Pennanen was asked to clarify whether this new activity i.e. the therapy pool activity, could be added to Arcada.

First the workplace planner (Ari Pennanen) and the architect (Stefan Ahlman) negotiated under which terms activities could be integrated into the present

design. The alternatives were extension now, extension later or replacing present activities with therapy pool activities. Their suggestion to the board was that some car parking in the cellar, close to main entrance, could be replaced by therapy pool activities. Design was stopped in this area but continued in other areas.

Ari contacted Folkhälsan's therapy operative manager and started workplace planning. This took 2 weeks and 3 versions. Folkhälsan's operative manager started with 480 netm2, but this was not accepted by the management of Folkhälsan. The Version on 28.2.2002 was 385 netm2 and 1,200 000 euros. It was accepted by Folkhälsan. Ari Pennanen informed the Arcada board of the proposed therapy activities that included:

- Pool activities
- Clothes changing
- Sauna activities
- Refreshment

The supporting activities were removed leaving only core activities. The teaching classes were to have access to these facilities in education and practical training.

The investment cost for Folkhälsan would have been 1,2 million euros (if they had bought else where). The rent was typically 6% of investment at that time. It increased Arcada building costs by less than 1 million euros, but car parking was replaced by therapy activities. The car parking was traded off in this case.

The Board demanded commitment from Folkhälsan within a week. By committing they would promise to pay the rent. The design team could no longer wait for the business developments, and so started design work to add therapy activities at Arcada's risk. If commitment could not be reached, the group would go on with the present design situation (car parking).

On 4.4.2002 Folkhälsan committed to the business development and the Board accepted therapy activities in Arcada. The design solution already existed and was in accordance with the workplace planning program. Ari Pennanen introduced a new budget at the next meeting. The Board accepted the new budget in which the Therapy activities raised costs by 740 000 euros. On 26.5.2002, Haahtela group confirmed that the design solution was now within the budget.

This case study entity is published in Michael Whelton's dissertation (Whelton 2004)

10 THE WORKPLACE PLANNING PROCEDURE

The Workplace planning Theory, principles and testing were presented in Ari Pennanen's licentiate thesis 25.9.1998 approved by Tampere University of Technology. The licentiate was published in 1999 under the name ”Space Quantification in Building Enterprises” (Ari Pennanen 1999). In this presentation the earlier licentiate has not been presented in its entirety. The focus is on the logic of the procedure. Architect Ilkka Niukkanen has taken part in the development of the system plan application. The programming has been carried out by Haahtela- kehitys Oy's programming group. The Web-based application has been produced by Haahtela-kehitys Oy under the supervision of Ari Pennanen.

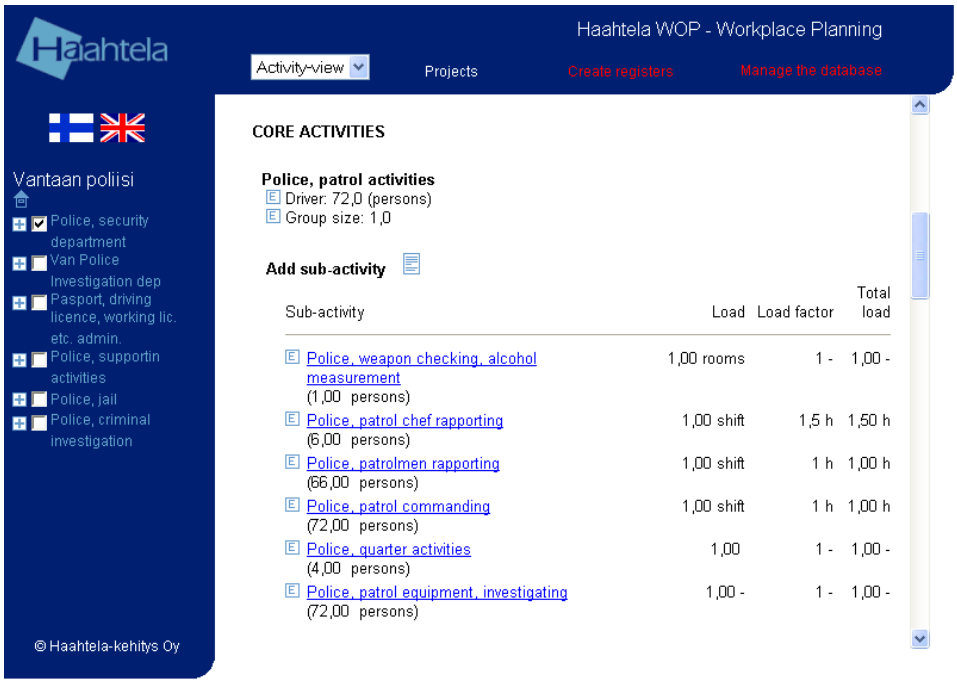


Fig 17. Haahtela Wop, Workplace planning application. Police security department patrol activity description

10.1 General

Workplace planning could be done by choosing a simple unit of measurement for the functions of a desired field of operations, and by connecting this measurement unit, through the process of statistical sampling, to the extensiveness of the Space Program. The measurement unit for a school could be the number of students, and the measurement unit for an office, the number of employees. These types of instructions for the quantification procedure were removed from use in Finland in 1980 for comprehensive schools and high schools (Tilantarve erikokoisissa peruskoulun ala-asteen ja yläasteen kouluissa sekä erillisissä lukioissa 1987) , as well as, daycare centers (Suunnitelaan päiväkoti 1991).

The advantage of this procedure is its simplicity. A disadvantage is that it does not describe differences in the statistical information used in the spatial programs, nor does it allow for the opinion of the individual or party to be heard, in regard to spatial resources. The method would state that for a 600 student junior high school one 60 m^2 computer science teaching area will be needed, but it could not explain why some schools have requested three teaching areas. Nor does it take into account functional variability. The number of classrooms for computer sciences is based upon the amount of teaching to be carried out in the subject. What if a school specializes in computer sciences and increases the amount of teaching? Due to the fixed methods lack of ability to describe information, standards would have to be created for so called building types: typical schools, typical office building, typical day care center, quantifying a library, e.g. Then one should to assume that the users internal functions are identical. The problem would have been ”tamed”.

Experience of project budgeting procedures has shown, that fixed methods linked to building types do not result in a large user pool. In Finland a more widely used budgeting procedure is the Target price –procedure (Haahtela & Kiiras 2003) that allows for the classification of space independent of the type of the building. Currently, pure building types are seldom built; an office building can include production spaces, storage spaces, a restaurant, day care center e.g. Also, within pure building types there is a notable functional variability; in an office there can be a lot or a little negotiation, personnel training may or may not take place there, eating can take place in the building or in the surrounding restaurants, the long-term archives can be kept in the office or at head office, the school can specialize in visual arts, music, or physics, e.g.

10.2 Activity Based Accounting and Workplace Planning Procedure

The structure of activity based accounting (see chapter 6) is suitable for studying the working environment and the resources spent on it. The working environment and it's expenses are widely considered as indirect overheads for an organization.

Product
An organization's business plan is normally divided into sectors. A university's sectors might be the construction engineering faculty, the electrical engineering faculty, the medical faculty and the social faculty, which are more or less independent. A rehabilitation center might be divided into brain injury and spinal core injury sectors. These sectors are considered to be products of an organization.

Activity
The business sector's operational work is carried out by activities, core activities and supporting activities. These activities realize the business sector's goals,

Resource
The rooms are the resources that are demanded by activities and thus can be traced to the activities.

Finally, by understanding why the activities are being performed, the activity's use of resources can be related to the demands for the activities by the individual products. Activity drivers are used to identify the linkage between activities and cost objects, such as products, services and customers. They serve as quantitative measures of the output of activities.

Product	Activities	Drivers	Resources
Construction eng	Core:		
Faculty	Language learning	students	lecturing rooms
	Mechanics learning	students	laboratories
	…		…
	teaching planning	teachers	office environment
	…		
	Supporting		
	Administration activ.	Employees	office environment
	Dining	students+empl.	Kitchen, restaur.
	…		
Brain injury	Core		
Rehabilitation	speech therapy	therapists	office environment
	Accommodation	patients	hotel rooms
	…		
	Support		
	Accounting	employees	office environment
	Ref. Library	volumes	shelves area

10.3 Factors Affecting Spatial Requirements

The wide applicability of the workplace planning procedure requires a theory of spatial requirements, which adequately describes the variability in the usage of space. Such a theory should encompass as widely as possible factors that cause differences in the amount of space required.

In the research hypotheses, such influencing factors are sought which can be modeled. Modeling requires that the factors can be described as measurements. The following human factors, for example, that most probably have some affect, but are difficult to measure, have not been included in the hypothesis (Pennanen 1999):

- People have a tendency in a new situation to desire space, which resembles the space in which they previously worked. It is difficult to begin working at a blank page.
- In organizations, spatial quantification may reflect organizational hierarchy. It has been the assumption of this presentation, that even traditionally hierarchical structures can be functionally described. Accordingly, the manager’s office is described as being larger than other offices because it must support the negotiating- and customer functions. If it is noted, that these functions are not needed, then these assumptions included, the managers office does not need to be larger than other workspaces.

The hypothesis is, that horizontal geometric quantification can be made accurately enough with the help of the following factors (Pennanen 1999):

- the total volume of the functional sector
- the activity bill programmed for the sector
- the time strain of activities and targets for the use of time in the space
- the geometry of the people working and the objects to be placed in the space
- legislation, instructions, norms.

Each hypothesis is described below using the example of the teaching sector

10.3.1 The Volume of the Sector

The product of the logistics engineering sector is learning, and to describe the volume of this sector, the number of students to be taught in a particular time span has been set. In the administrative sector the product can be described as the size of the organization and in manufacturing the number of items to be produced (Pennanen 1999).

If there are 400 students in a junior high school, one 80 m^2 teaching area for physics is needed. If the student body grows to 500 students, one more teaching area will be needed, and eating-places will need to be creased etc.

10.3.2 The Activity Bill to be Programmed to the Sector

The activity bill to be defined depends on the strategic choices made by management. The choice of bill describes with which core activities the goals of the sector are realized, and to what extent support activities are needed. For eating and food preparation, spaces can be programmed, or personnel may also use luncheon services in the neighborhood. A regular exercise hall can be reserved, or providing the school with a gym and aerobic hall can raise the activity level. Teachers can plan their curriculum at home, or in the staff room, or a workplace can be programmed for them. Personnel who come to work by bicycle may be provided with washing- and changing room facilities. There is great variance in activities programmed to sectors and the criteria is very often subjective (Pennanen 1999).

10.3.3 Temporal Load of Activities and Goals for Operating Degree

Operations take up a space or part of that space for a definite period of time. A meeting is scheduled for two hours and afterwards that space will be available for another meeting. The expected level of efficiency affects the quantity of space and the flexibility of activities. If the four one-hour meetings of a work shift are held after one another, one conference space is sufficient. If parts of

the meetings are to overlap, then two conference spaces are needed, both having a low utilization degree. The temporal requirements are named the temporal functional load. The capacity of the space to accommodate the strain is referred to as the potential utilization degree (Pennanen 1999).

Load

At the police investigative department 11 interviews are organized in a day. The interviews take an average of 2 hours. The activity's load on the conference spaces is 22 hours.

At the university, leadership is taught for 26 credits during a period of three years, each credit includes 20 hours of supervised teaching. The yearly intake is 110 students and leadership is usually taught in groups of 10. The load of the leadership groups on the teaching space are during a time span of three years 6 864 hours.

Utilization Degree

In the post occupancy evaluation of conference spaces of Compaq in their office building in Finland, measurements show that with a utilization degree of 50 % there is usually access without waiting for a conference space (Pennanen 1999). If a 50 % target utilization degree is set for the space used by the police, the space allocated for interviews can accommodate 4 hours of functions a day. Then six interview spaces will be needed. If a schedule can be made for the interviews, and the space for the interview is booked in advance, the utilization degree can be raised to 75 %. Four spaces to conduct interviews will then be needed.

During a period of three years the university spaces can accommodate 4 320 hours. Experience in schools has shown, that if the utilization degree exceeds 80 %, there seems to be a shortage of space. If the target utilization degree of the space used for teaching leadership is set at 75 %, then three teaching areas will be needed.

10.3.4 The Geometry of the People and Objects to be Placed in the Space

People use space as their workplace, production processes are organized in space, things are stored in spaces and people sleep in spaces. Each performance action requires the space planned for it. The minimum width of the seating space needed for an adult is 0,45 m. The measurement of a seated adult from the back to the knees is about 0,60 m. In offices, most folders and magazines are size A4, and fit in an about 330 mm of free shelf space. A walking person needs approximately a 700 mm wide space in front of the document shelf. On clothes hangers, outdoor clothes require a depth of

600 mm and each hanger a width of 150 mm (Pennanen 1999).

The company manager requires a work station of approximately 5 m^2. If the manager wants to store documents in the room, 10 m of shelf space can be reserved, which will increase the size of the room to approximately 7 m^2. The two wardrobes placed in the room will increase the room's surface-area to 8 m^2. The manager wishes to place a conference point for six persons in the room, which will increase the surface-area to 17 m^2. If a screen for viewing is required, the manager will need a 22 m^2 room.

Physics can be taught in groups of 32 students, with 12 regular student seats and 20 workspaces for examinations. In addition to this, 14 m^2 of bookcases should be reserved for storing collections nearby as well as the teacher presentation area. In all an area of 80 m2 is required.

10.3.5 Legislation, Instructions, Norms

Society defines workplace planning through legislation, instructions and norms. Legislation dictates, for example, the surface-area of an air-raid shelter in relation to square footage per floor or population. The Department of the Environment has standards for the minimum requirement size of storage space in apartments. An example of standard practice is the size of a basketball field.

10.4 The Structure of the Workplace Planning Procedure

10.4.1 General

The spatial resources are traced to the activities and to the functional sectors by a structure similar to activity based accounting. Creating the model is basically creating functions that set the default values to linking drivers, between sector, activity and spaces. When operating the model the information goes the other way around, the model traces the need for resources (spaces) to sector, based on default or desired driver values. In order to use efficient drivers, the quantities of the sectors, activities and actions must be described quantitatively. A quantitative description often seems forced and unaccommodating of slight variations, but it is necessary for the purpose of a calculative model.

The workplace planning procedure model can be constructed using interviews without any initial information, but the procedure is much quicker and thus more usable when it is supported by registers and the default values of drivers.

Registers of sectors, activities and rooms are created to meet observed reasonable practice. The registers do not necessarily define what a particular organization wants, but by modifying drivers, deleting and inserting activities and reshaping spaces they can quickly be altered.

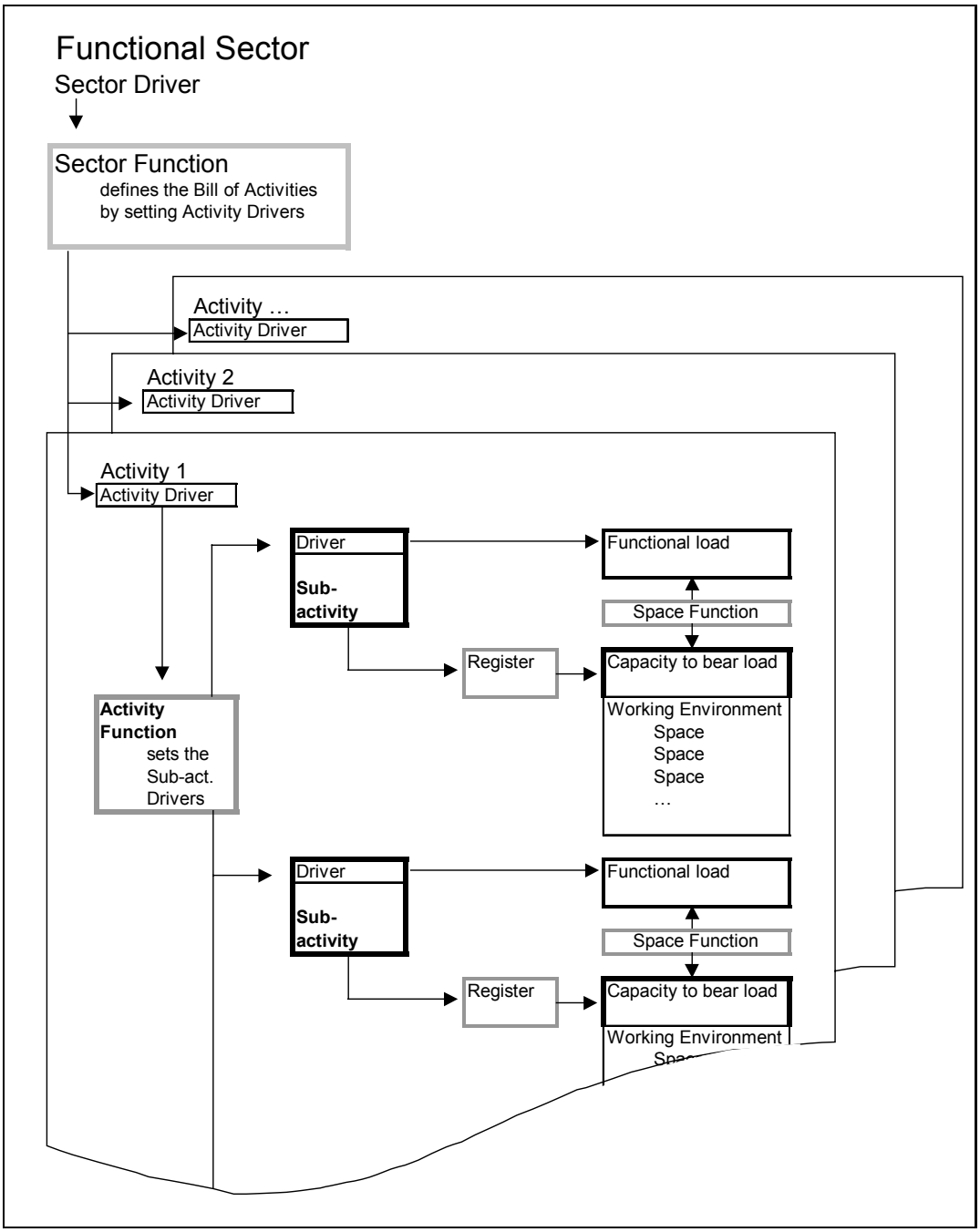


Fig. 18. Hierarchy of the Workplace Planning Procedure

10.4.2 Project

A project is a group of functional sectors that are planned to be located in the same site or building (sector, see next). In today's world a project is something other than a building type, it is often a multi-user working environment. The project is considered to serve as an "umbrella" for one or many functions, e.g. an office combined with a library.

In the workplace planning process any functional sector can be combined with any other sector. In an office there might be a day care center and a dentist's practice. By combining and optimizing (see later) The Workplace Planning Procedure seeks synergies among sector activities.

10.4.3 Functional Sector

The functional sector is a group of activities programmed to achieve a particular independent goal. An independent goal means that it is possible to program as an independently functioning building entity. In a day care center, for example, independent goals or sector definitions are the day care of 1-2 year olds, 3-6 year olds and children's preschool. By combining the above sectors in a desired way the Day care center type of building is obtained. In the police building, the sectors are security, investigation, license management and mobile police. In a school the sectors are elementary school, junior high school and the high school class years. In a polytechnic the sectors might be studies in finance, catering studies, health care studies etc. In the church the sectors might be the service, social work, youth work and family events.

For each defined sector a sector-function is created. The sector-function uses as its value of origin the sector-driver chosen to describe the volume of the sector and returns the drivers of the activities (activity functions, see later).

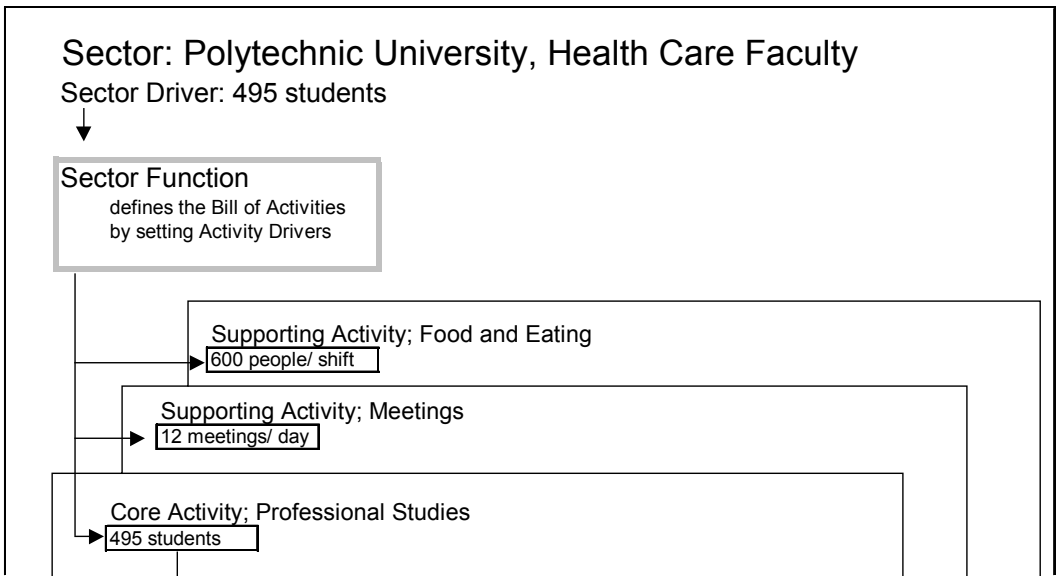


Fig. 19 Heath Care Faculty and some activities

10.4.4 Activity

An activity is internal to the sector and has an established task- or product concept as a part of the core meaning of the company/plant. For example, the activity of catering produces both food for personnel and the eating environment, the archive activity provides both short-term and long-term archive facilities, the accounting activity is responsible for internal and external accounting, the building maintenance activity is responsible for maintenance etc. The entire function of the sector is completely and totally described as being produced by activities.

For each defined activity an activity-function is created. An activity-function uses as its value of origin the activity-driver, and returns the drivers of the sub-activities defined to the activity.

10.4.5 Sub-activity

It is useful to describe activity in terms of sub-activities, so that the activities important in strategic decision-making do not become too large. The sub-activity is an isolated task that produces the output of the activities. For example, the nutrition activity requires the following sub activities:

- food preparation
- eating

In the sub-activity the information about the load a function puts on the spaces is recorded. Their load on the spaces is temporal (the police security

department consists of six patrols and the leader of each patrol reports in writing two hours in a shift) and non-temporal (20 000 volumes need space in a library).

To the sub-activities space or spaces are connected as a working environment. The organizations sets goals for the potential utilization of its spaces. A meeting room is in use from 8.00 a.m. to 5.00 p.m. and higher utilization than 60 % causes queues. In the spaces the information about the required utilization degree is recorded. Based on the above the space function returns the quantity of space or spaces with a standardized measurement unit (for example 5 one person offices, a 120 person eating space, 100 shelve meters of storage, 3 units of conference space, a 10 person’s landscape office etc).

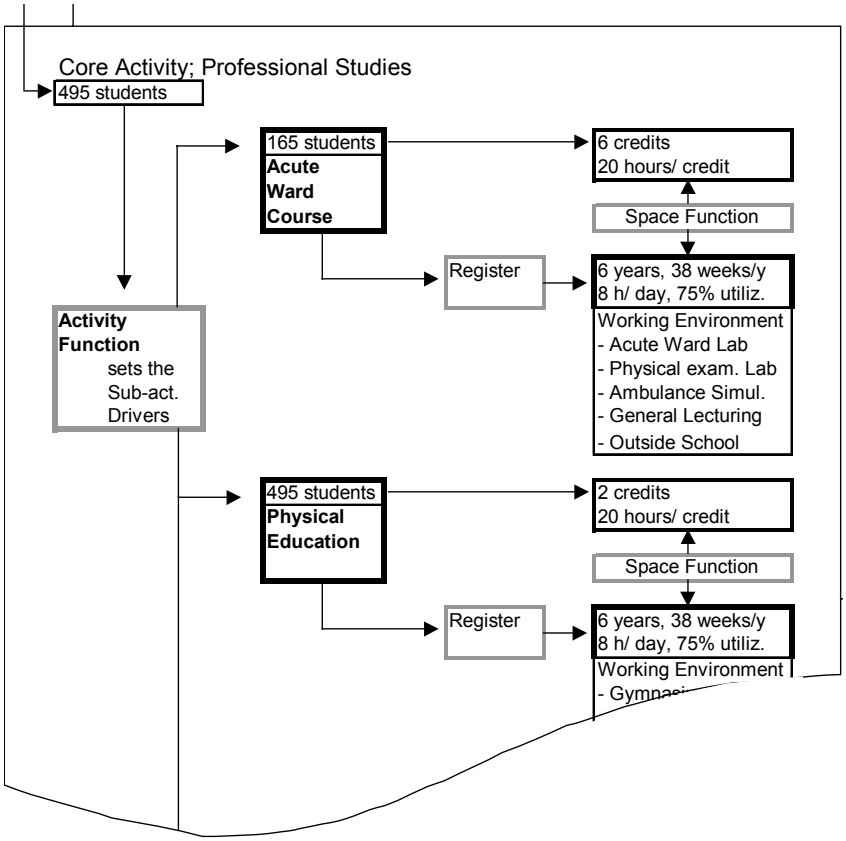


Fig. 20. Example of activities and sub-activities

10.4.6 Space

Ordinarily, space means the general concept of space used in the building industry (a specified area and use, for example an office of 12 m2, a doctor's reception area of 15 m2 e.g.). In the larger meaning, it also means the same use, but without the previously described boundaries (for example: 160m2 of near storage is needed, the manner of placement and the size of places are defined in conjunction with the planning).

In the Workplace Planning Procedure space is approached from two perspectives.

1. The number of spaces is defined through observation of the functional load on the space and the capacity of the space to accommodate that load
2. The size of the space is defined through observation of the performance results (actions), that take place in the space.

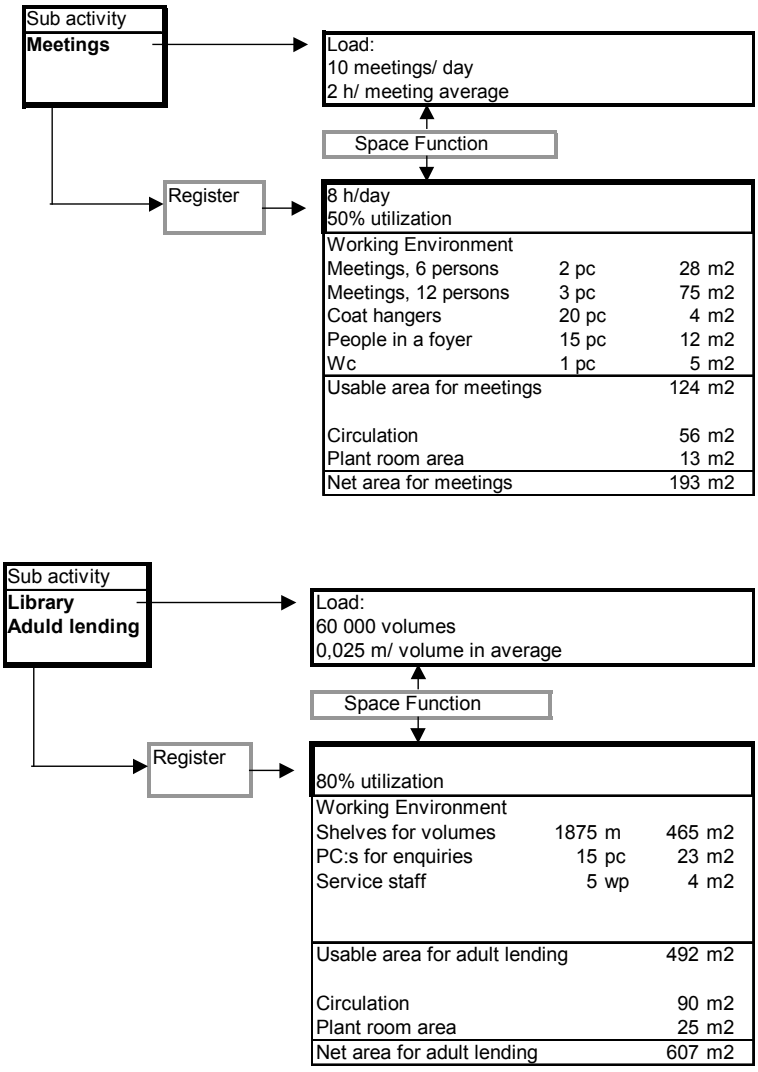


Fig. 21. Some examples of Sub-activity and Working environment

The working environment is defined within the target utilization (if set). If the load is small compared to the time capacity of the space, the realized utilization degree might be much lower than the target. It is shown in the output data.

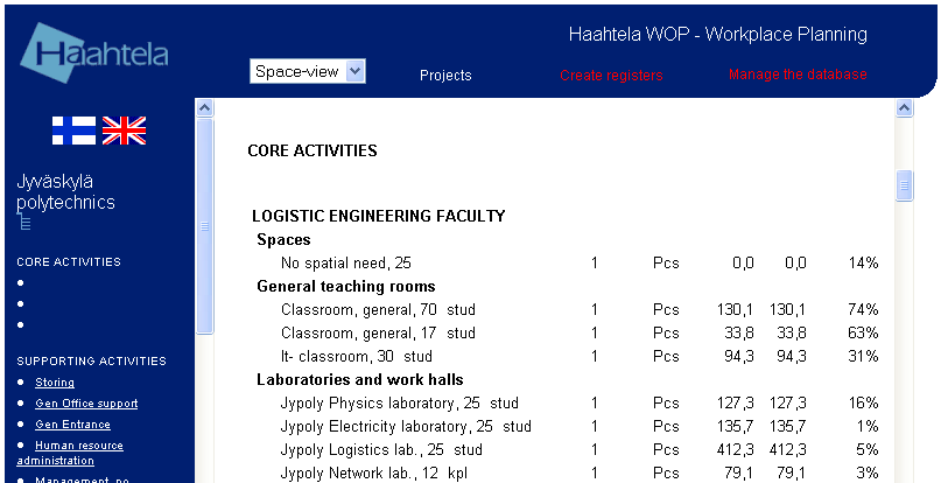


Fig. 22. Logistics engineering laboratories' realized utilization degrees are low. Few courses (activities) demand this particular resource and even then only for a period of a few weeks. The actual load is low compared with the potential load on the spaces.

10.4.7 Action

The action describes the basic performance activity and its plane geometrical space requirements. A fixed register has been compiled of the actions, for example, working whilst seated requires a 6 m2/work station. The register follows the following classification:

Standing
Sitting
Seated working
Document Storage
Industrial and store warehousing
Clothes maintenance
Sanitary Facilities
Rest
Performing
Food preparation
Machines, equipment
Property Maintenance

The action function uses as the measurement of origin the default action parameter, circulation parameters, and technical parameters and returns the floor area of the space.

Space name Office work and 6 persons meetings		
Actions		
Working at table & adjacent table	1 pers	6 m2
Storing in cupboards	1,8 m	2,3 m2
Book shelving	10 m	1,9 m2
Having meetings	6 pers	9,2 m2
Having performances	6 pers	4,6 m2
Usable area		24 m2
Circulation area		8,5 m2
Services area		1,9 m2
Net area		34,4 m2

Table 2. Example of a space and actions

The register of actions is based on

- the measurements in real working environments
- the measurement on the final design solutions among clients
- tests connected to the target price method (Haahtela & Kiiras 2003)
- some other sources (Neufert 1980)

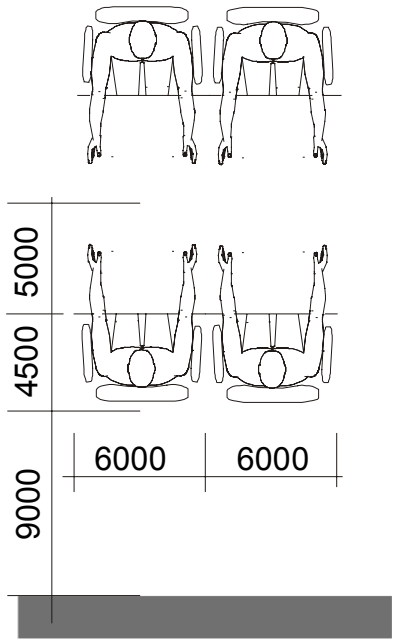


Fig. 23. Practical dimensions for meetings (Pennanen 1999)

10.4.8 Parameters

In addition to drivers, functions also use parameters. They are recorded to the registers as default values and are easy to change when customizing.

Load
Load is used to describe the resource that activity demands from the space(s).

Share of the load
The load can be allocated to the working environment with a share of the load-factor, e.g. 60% of meetings are small (6 persons) and 40 % medium sized (12 persons).

Group size, functional
Group size affects space sizes and the number of spaces, e.g. one 50 person space or two 25 person spaces.

Group size, actions
If this parameter is defined, it over-rides previous Group size when actions are considered. For instance, it is possible to state that lectures will be held in 28 groups (defines number of spaces) but to increase flexibility rooms will be provided for 32 groups.

Swap-parameter
Normally group size is a given value and the quantity of spaces is an outcome. The swap-parameter fixes the number of spaces and the group size is an outcome. For instance if 300 dining spaces are needed, with a swap-value 2 it will be defined as two spaces for 150 persons.

Target utilization
The factor defines the maximum utilization degree that can not be exceeded.

Delivery circulation parameter
This defines the need for delivering circulation space, i.e. circulation flow between spaces. When small spaces are considered, circulation occurs in corridors. As spaces become bigger, part of the circulation is removed to the usable area.

Sector-circulation parameter
This defines the requirement for stairways.

Services area parameter
This defines the requirement for services areas.

Time model
The time model expresses the period during which the spaces are in use. The temporal load is studied against the chosen time model. The time model's parameters could be 8 hours a day or 3 years, 38 weeks, 5 days a week or 8 hours a day (high school model).

Parent parameter
The parent parameter indicates whether the activity can be combined with another.

10.4.9 Combining and Optimizing

Activities demand spaces due to their functional load. The load might lead to low utilization of a space. The combining procedure seeks similar spaces with low use. It suggests that some activities could be combined within the same environment within the target utilization. The optimizing procedure finds different sized (different group size) spaces which are similar by actions. It suggests that if there are large and small spaces needed with low utilization, only the large is needed and the smaller space's activity can be held there.

An example

There are three sectors in a City Police Station that hold interrogations. They have not previously defined interrogations as an activity. The office rooms have been large enough to hold interrogations in. In spring 2003 City Police started workplace planning in order to define its future working environment.

Interrogations were defined as an activity in the Workplace Planning Procedure:

Sector	Driver
- police security department	4 interrogations/ day
- police investigation department	10 interrogations/ day
- police criminal investigation department	17 interrogations/ day

The activities needed 350 m2 of net area (usable + circulation + services) altogether. The optimizing procedure was used to test how much space was needed if a common working environment was shared. To ensure flexibility a 50 % target utilization degree was set. The result was 272 m2 altogether. In the workplace planning dialogue process the operational management started to study if the interrogation working area really could be shared.

It was found that there were advantages and disadvantages:

- if the departments had their own interrogation areas, they would be closer to the detectives' working places
- if an "interrogation hotel" was designed, it could be located close to the main entrance and close to the police jail cells.
- An interrogation hotel would be more efficient
- The organization is changing all the time. An interrogation hotel would be conveniently situated even if the departments changed their position within the building.

In summer 2003 it was decided that interrogations would be held in a shared "interrogation hotel".

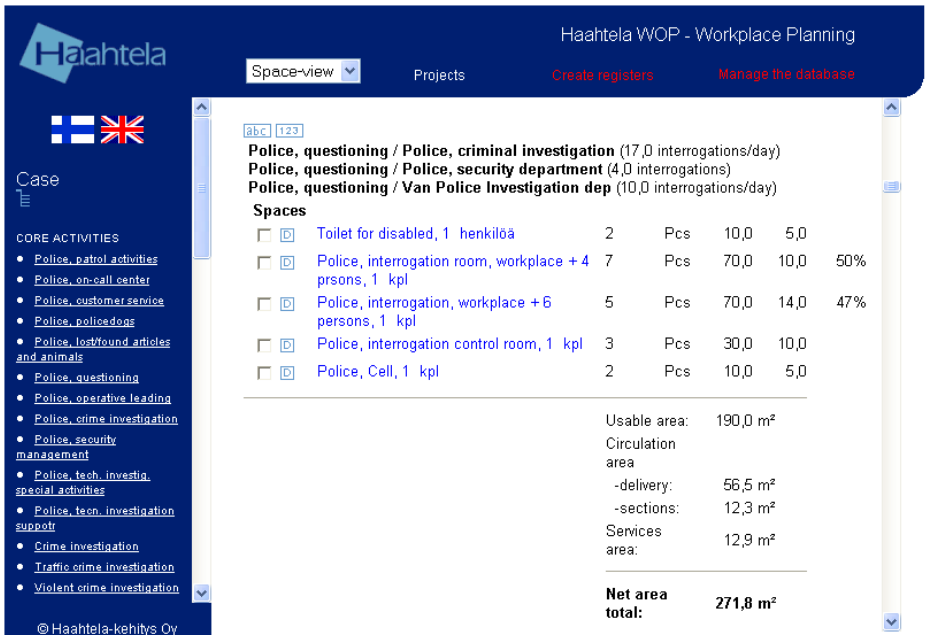


Fig 24. Shared interrogation area, “interrogation hotel”

11 CASE STUDY; CYGNAEUS HIGH SCHOOL

11.1 Introduction

Cygnaeus high school is located in Jyväskylä, Finland. The school was built in the early 1960's. At the moment it is somewhat substandard technically and functionally:

- teaching methods have changed since the school was built
- regulations concerning hvace have changed since the school was built

The existing plan of the first floor appears in appendix 3.

A architectural programming was conducted in 1997 and again in 2002. This did not lead to investment. The Haahtela Project Management Group was employed in spring 2003 to undertake the workplace planning process using the Steering Model of Workplace Planning. The Haahtela Group was led by Ari Pennanen. The other members were architect Ilkka Niukkanen and Michael Whelton.

Ph.D. Candidate Michael Whelton from University of California at Berkeley worked during spring 2003 in the Haahtela project management group as a workplace planner (Cygnaeus High School, Vantaa City Police, Stadia Polytechnic). He made case studies of workplace planning as part of his thesis (Whelton 2004)

Workplace planning of Cygnaeus high school is later presented in the context of the workplace planning steering model (Fig 25).

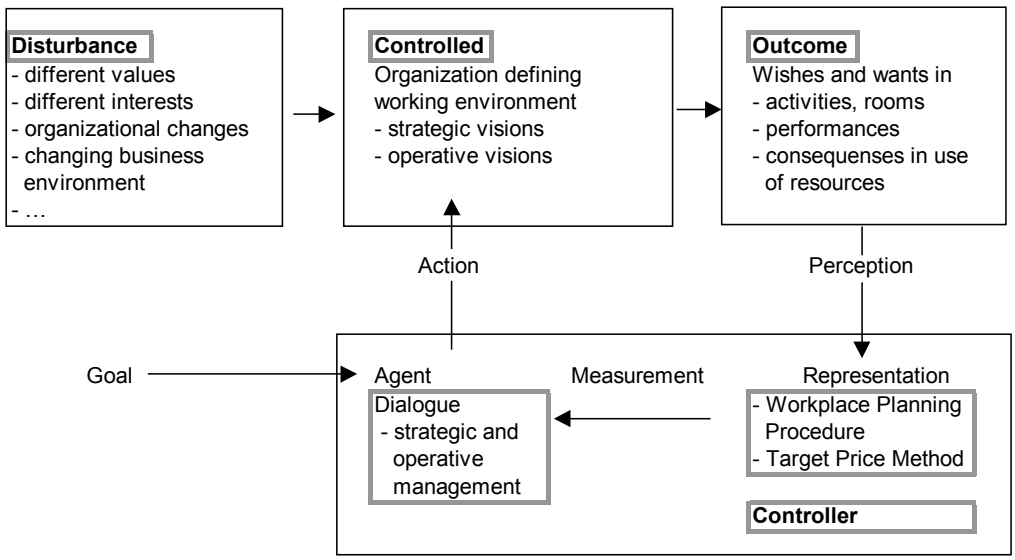


Fig. 25. The workplace planning steering model

11.2 Stakeholders

11.2.1 Education Policy

The City Department of Education coordinates high school education in the Jyväskylä city area. Economical planning and budgeting in all high schools are the responsibility of the City Department of Education.

11.2.2 Real Estate Policy

Jyväskylä City's real estate organization is responsible for building, renovating, leasing and maintaining the high school property. Jyväskylä City Department of Education pays rent per square meter for using buildings. The Cygnaeus high school renovation/extension project was led by Jarmo Hulkko, head of the project managers.

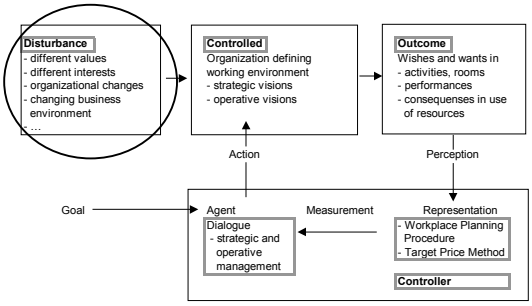
11.2.3 Education in Practice

Education is carried out by Cygnaeus high school teachers. The staff is led by the principal and the vice principal and the principal of adult high school education (adult education will be held in the same facility in the evenings). Teachers plan education under the policy of the City Department of Education.

11.2.4 Students

Pupils in Cygnaeus high school are represented by the Student's Association.

11.3 Programs 1997…2002



The selected architectural programmer, specialized with renovations, was commissioned to do the first programming draft in 1997 by the city real estate organization. The planning team consisted of city real estate personnel, the school headmaster and the architect. The architectural programmer's working method in the beginning was basically Problem Seeking, as described in chapter 1. The city representatives also wanted a visualization (sketches and a mass model). Later the city cost planner prepared the cost estimation. On 20.11. 2002 the program was updated by the same team. The program consisted of a list of rooms, the requirements of the rooms, the existing building condition survey, and the budget for investment. The extent of the space program was 8 150 net m2 (usable space + circulation area + services area, measured from the inner skin of the rooms). The program and budget would amount to 800 000 € rent/year in spring 2003.

The program was cancelled, "put on ice" (Whelton 2004).

- The principal felt that those in the City did not understand the role of school.
- Teachers felt that they have a strong vision what they need but the city was not very collaborative
- The city found that the program was too expensive. The investment would raise the rent too much for the City Department of Education
- The real estate organization felt that the programmer had little control over the budget and wishes
- The real estate organization (Jarmo Hulkko) felt that they had a policeman role. They could only say that things were too expensive and could not see

how to reduce one need over the other. They lacked tools to rationally decide what needs could be included in the program. The real estate organization felt that the school was not very collaborative.

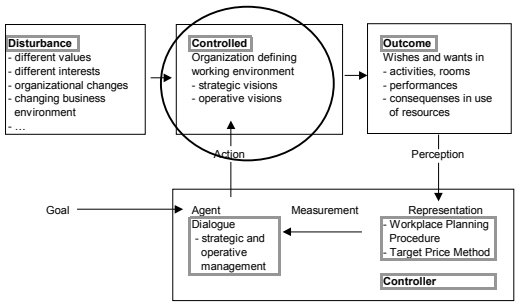
- The real estate organization felt that the users did not see that their space would be unused

If we consider the organization as a complex social system, there was a lot of disturbance that pushed the project out of balance. Commitment was not achieved.

11.4 First Representation of Workplace Planning Steering Model

In spring 2003 the workplace planning process was started under the management of the Haahtela Project Management Group using the Workplace Planning Steering Model.

11.4.1 Organizing the Client

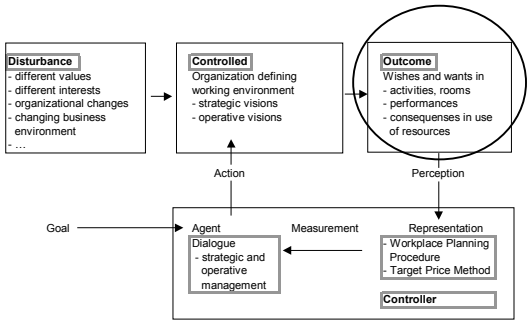


Operative managers were selected from the teachers and the staff responsible for other activities (library, catering etc.). Every subject in the curriculum was represented by a named teacher. The named teacher could ask colleagues for assistance if desired.

Strategic management was formed from managers of the City Department of Education and the City Real Estate Department.

The principal was represented in both strategic and operational management groups.

11.4.2 Bill of Activities and Drivers



The first proposal for the bill of activities was created by the operational management group and was accepted by the strategic group. The bill of activities determination was supported by the benchmark register of workplace planning procedure.

Sector driver

It was decided to quantify the future volume of the core activity by the predicted number of students studying at any one time. The City Department of Education set the driver at 650 students (all classes present, forecast for 5 years).

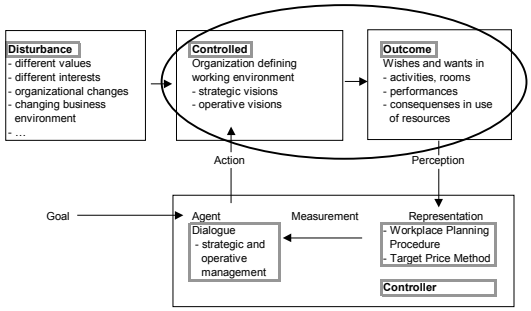
Core activities

The core activities were set as the learning of the s. In order to characterize the working environment in terms of transformations and flow, it was decided to examine the students' presence in various learning environments course by course. Thus the activities were formed by courses and their temporal loads on the learning environments. The sector driver was usually the driver of core activities. Core activities are shown in appendix 1.

Other activities

Supporting activities, activities for staff and activities for building management are shown in appendix 1.

11.4.3 Interviews



Operational management was interviewed in order to connect the learning environment (spaces) to the activities. The teachers' vision was a modern high school without permanent classes. Teachers were asked to define their teaching methods in various teaching environments. Because the spaces could be designed in numerous different locations in the existing building, the teachers were asked to concentrate on teaching methods and learning environments, not on their locations in the existing building.

The curriculum determined the temporal load (it's maximum). Spaces and actions defined what environment. For the learning environment a 75 % target utilization degree was set to ensure flexible scheduling (meaning 6 hours/ day). Some examples:

Core activity: Optional courses
Driver: 650 students
Sub activity: Physics learning
Driver: 300 students
Load: 3 courses, 38 hours/ course

Desired learning environment:	groups	share of the load
- general lecturing	200 stud	10 %
- studying in natural science classroom	32 stud	50 %
- studying in it-class	32 stud	40 %

Supporting activity: Library
Driver: 13 000 volumes
Sub activity: Material process support
Driver: 3 employees
Load: not handled

Desired working environment:	groups	share of the load
- work at table	landscape	100 %
- material stored at workplace	landscape	100 %

Sub activity: Reference library

Driver: 13 000 volumes

Load: 0,025 m/volume

Desired working environment:	groups	share of the load
- magazines	landscape	not handled
- volumes on shelves	landscape	100 %

Internal operation in spaces was transformed to Workplace Planning Procedure's standard actions. An example:

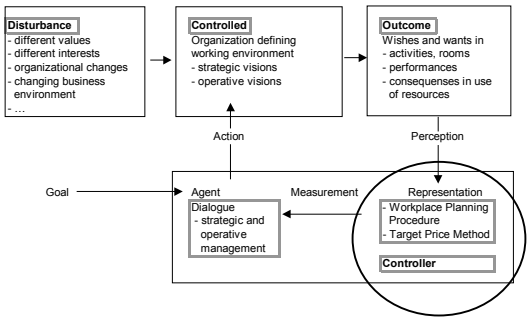
Space: Music class

Driver: 44 students

Actions:

- lecturing	44 stud	13 m2
- working at table	44 stud	68 m2
- band/chorus, sitting or standing	22 stud	18 m2
- piano playing	2 stud	6 m2
- storing in cupboards	11 m	15 m2
Usable area		**120 m2**
Circulation area		22 m2
Services area		7 m2
Total net area		**149 m2**

11.4.4 The Representation



The workplace planning procedure calculated spaces needed for activities, their sizes, their utilization degrees and the total net area. Some examples of output data are presented in Figure 26. According to the activity survey, the clay and design room for 11 students requires a 22 m2 space. The space will be in use for two hours a day on average (27 % x 8 h).

Music classroom, 20 stud	1	Pcs	62,6	62,6	31%
Storage for music classroom	1	Pcs	37,0	37,0	37%
Clay and design classroom, 11 stud	1	Pcs	22,2	22,2	27%
Teachers individual work / Sch High school (70,0 teachers)					
Spaces					
Office Workplace, temporaty wrk, 70 persons	1	Pcs	230,4	230,4	18%
Gen Food and eating / Sch High school (585,0 persons)					
Spaces					
Eating area, 260 seats	1	Pcs	332,8	332,8	75%
Dish return, 260 meals	1	Pcs	7,2	7,2	75%
Food cooking and receiving, 585 meals	1	Pcs	55,0	55,0	
Receiving goods, 585 meals	1	Pcs	11,4	11,4	
Waste room for kitchen, 1 shelve m	1	Pcs	5,0	5,0	
Dressing room for personel, 5 persons	1	Pcs	7,8	7,8	
Food delivery , 260 meals	1	Pcs	21,0	21,0	75%

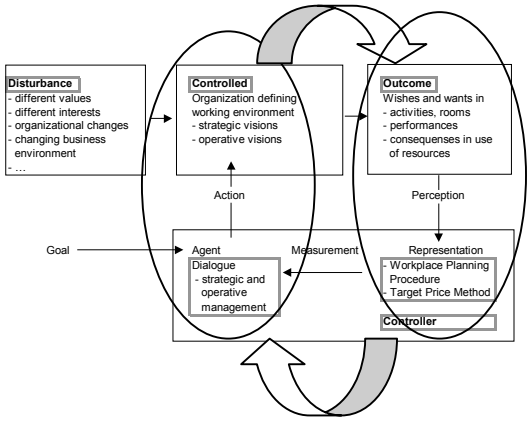
GRAND TOTAL:	Usable area:	5 156 m²
	Circulation area	
	-delivery:	812 m²
	-sections:	275 m²
	Services area:	327 m²
	Net area total:	**6 570 m²**

Figure 26. Examples of the output data of the Workplace planning procedure.

To ensure transparency and to support commitment, the presentation was re-submitted to operative management. The workplace planning procedure is a web application. Teachers were able to access the model and check that all information was understood and handled properly. The set of issues raised were as follows (Whelton 2004):

- an average group size was set at 32 pupils. This size did not satisfy teachers and they were able to adjust sizes course by course
- the principal noted that the oldest pupils leave school in late spring. It is hard to force other classes to work longer on that time. Thus the utilization degrees are lower at that time. It was decided to use lower targets for utilization degrees (75 > 73 %)

11.5 Discussions with the Users

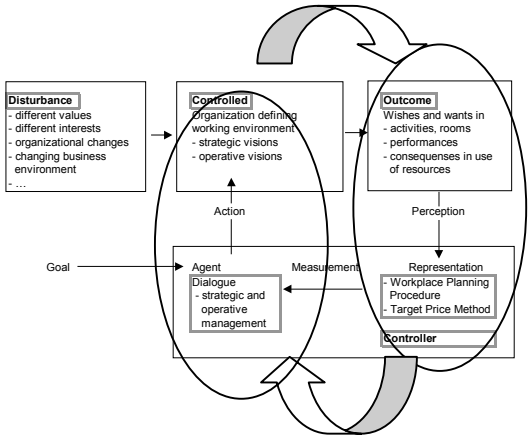


Teachers were asked to acquaint themselves with the perceptions of activities and spaces in the meetings 6.3. – 15.4. 2003. Many of the meetings were held internally, without the workplace planner. The operative representatives were familiar with the representation, could describe it to their colleagues, gather new information and transfer it to the workplace planners by phone and e-mail:

- in the representation only one music-teaching area was deemed necessary with maximum utilization (75 %). Cygnaeus high school emphasizes music- teaching. More flexibility and lower utilization were required. *Action: A second music space was allocated.*
- the vice-principal noted that the initial workplace model did not take into account the teacher's desire to use several classrooms at the same time. The teachers wanted to have lessons in one classroom for half an hour and then split the pupils into two classes for the rest of the hour, so the teachers would need two classrooms for one group session. The workplace planner suggested that this could be taken into account only by using a lower utilization degree. The principal acknowledged that this request would lead to lower utilization. *Action: The principal said that such low utilization would not be wise.*
- there were comments concerning almost every specialized classroom by teachers

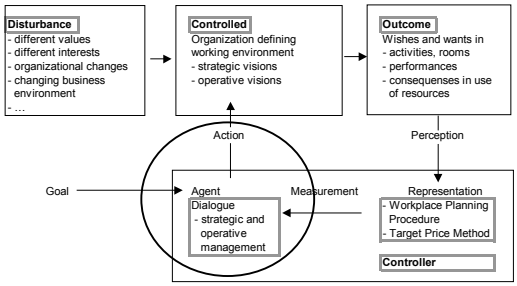
The corrected representation (version 3) was 6 926 m2 net area. It would result in 670 000 € rent/year.

11.6 Discussions with Strategic Management



The representation was introduced to the City Department of Education and the City Real Estate Department by phone and e-mail during 8.4.-14.4.2003. The workplace planner was asked to prepare a suggestion on how the school program could be further reduced without losing functions and activities. *Action: Haahtela prepared a program version 3.1 by optimizing all the utilization degrees of the classroom close to the target of 73 %. Sometimes it was possible only by combining diverse activities within the same spaces. Version 3.1 gave a space size of 6089 net m2 It would result in 580 000 € rent/year*

11.7 Strategic Project Meeting



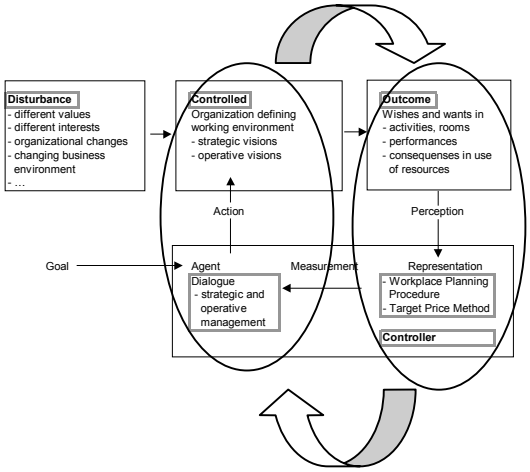
Once Haahtela had a consensus on the nature of user needs, they were in a position to approach strategic stakeholders with new information at a strategic client meeting in Jyväskylä city on 15.4.2003. This meeting included the school principal, the vice-principal, the city real estate management, the city management of schools and the Haahtela team. At this meeting the principal said that the workplace planning program was acceptable with minor

corrections and that the teachers understood and accepted it. They said that they would prefer the program version 3 which had a greater spatial area of 6926 net m^2.

The city proposed a target cost that would make the project feasible for further development. Through the use of the workplace information, they had a dialogue on different approaches to make the project work financially. After much discussion the city and school agreed. The group negotiated a target between versions 3 and 3.1. This decision to create a target allowed the project to proceed. The city left it to Haahtela to work with the school groups to make the necessary spatial changes without losing user functions. Haahtela agreed to work with the school operation stakeholders to establish a revised program based on this agreed target.

11.8 Further Dialogues

11.8.1 Operative Managers Meeting 6.5.2003, started at 9.00 am



Haahtela arranged a final workshop with the teaching group leaders to make the necessary changes to the workplace on 6.5.2003. This meeting included the school principal, the vice-principal, the principal of adult education, and the Haahtela Workplace Planners. In this meeting the group had a clear target; i.e., a mean value target of program versions 3 and 3.1 which meant achieving 6508 m^2 net area of program space. The city management had agreed that the operative managers of the school make decisions to achieve this target. In this meeting Haahtela had to allocate spatial resources to the user activities. The group had several discussions during the day to seek a means of reducing the program space demand.

Fig. 27. Workplace Planning Meeting in Cygnaeus school 6. 5. 2003

Haahtela began the workshop by examining spaces with low utilization in core activities.

Discussion about the auditorium.

There was an auditorium for 220 students (270 m2) in version 3.

- *Workplace planner*: The need for the auditorium for education is very low, it is almost unused (2 % utilization, if someone opened the door 100 times on any given day, the auditorium would prove to be in use on two occasions and it would be empty on 98 occasions). Furthermore, the auditorium would use a lot of resources.
- *Principal*: This is true, but the auditorium is needed for large groups undertaking final examinations before graduation. Smaller groups need too many teachers for supervision which then disturbs education during their exam period. Examinations use few temporal and many spatial resources.
- *Workplace planner*: We can combine three 80 m2 classrooms for such occasions. We should invest in portable walls with good sound insulation to make classrooms flexible.
- The idea was accepted by the teachers and the auditorium was removed

The discussion about computer labs.

- *Workplace planner*: The teachers had stated that much education occurs in the computer teaching areas. They have a high degree of utilization but they are bigger than normal lecture areas.
- *Teachers*: The aim was to enable computer work and normal class work with manuals, writing etc. to occur at the same time.
- *The vice- principal:* In future the students would use laptops, which are more portable and that normal classrooms would also be used for internet work.
- This conversation created the option of relocating temporal load from computer areas to normal lecture areas

The discussion about music workplaces

- *Workplace planner*: Music teaching areas must be discussed again. There are currently two large music workplace areas with rather low utilization in the present perception (2 x 45 pupils, 250 m2 + 250 m2, 37 % + 37 % utilization degrees). Would it be possible to manage with one area, as acknowledged utilization would be rather high (74%)?
- *Principal*: The school aims to provide a high standard of music education, so low utilization would ensure higher flexibility.
- *Workplace planner*: There is a music studio in both music classes. The utilization degree of these should be investigated. Are group sizes really so large?
- It was decided, that there would be two music classes, but that teaching would be reorganized so that the one classroom would serve for maximum 40 pupil groups and the other would serve 20 pupil groups. Only one music studio would be needed.

The meeting moved the group discussion to the issues of supporting activities in the school.

Discussion about teachers workplaces

In the existing model, the teachers used a dense hot-desk landscape office as their working area (70 teachers, 35 workstations).

- *Vice-principal*: All teachers would like to have their own workstations.
- *Workplace planner*: It would lead to an even bigger net area. The workstations would be in very low use. A teacher uses that that kind of workstation for less than 2 hours a day (as observed during the day).
- *Principal*: Teachers want their own workstations, but the they could be smaller
- *Workplace planner*: Could the teachers' work area function like computer classrooms or like meeting areas

- *Principal*: Yes
- It was agreed that every teacher would have a workstation with quite a low utilization degree (18 %). The actions would be changed as follows (Fig 28 and Fig 29):

Space "Teachers workplaces" includes following actions:

Amount (d): 35 (yleensä tämä on ryhmäkoko)

Circulation param: 3

Action	N-function (swapping)	Dimension function	Shelves	Area
35 x Space for work, papers on both sides	n=d	a=4.03	1	141,05
140 x Normal shelves	n=d*4	a=0,94/n	5	26,32
		Internal circulation		34,96 m²
		Usable area:		**202,33 m²**

Fig. 28. Teachers workplaces, previous model

Space "Teachers workplaces" includes following actions:

Amount (d): 70 (yleensä tämä on ryhmäkoko)

Circulation param: 2

Action	N-function (swapping)	Dimension function	Shelves	Area
70 x Space for work, papers on one side	n=d	a=2.7	1	189,00
210 x Normal shelves	n=d*3	a=0,94/n	5	39,48
		Internal circulation		20,68 m²
		Usable area:		**249,16 m²**

Fig. 29. Teachers workplaces, new model

Discussion about kitchen operations

It was found that the school could remove the kitchen operations and operate with a food distribution space only. The city representatives and the principal had earlier discussed bringing food in from a city-run central kitchen. A

catering expert from the city was invited to the meeting. Together members of the group defined a restaurant environment. They made new changes to the operation of food preparation by planning for a distribution kitchen, and not a preparation kitchen; the serving of food could use line distribution only. A smaller eating area was considered adequate. The new area was modeled using the workplace planning procedure. The new catering area was 170 m2 smaller than before.

Discussion with pupils association

The pupils association representatives came to the meeting. They stated that:

- The existing dining area is too small
- The association needed a club; a meeting area for 10 persons + workstations for two
- group work areas should be added
- pupils would like to have sofas in the entrance lobby

The dining area and group work areas were already modeled to be larger in the present representation. The meeting agreed to add a club for the pupils association.

Other decisions

Core activities

- Half of the biology education hours originally planned in the biology area were transferred to a normal lecturing space

Supporting activities

- One tutorial more was needed for the education staff to support operations
- Shelf storage was reduced to 10 m/teacher
- A shower/dressing area for teachers was added

At 12.00 Ilkka Niukkanen transferred the new data to the Web-based Workplace Planning Procedure and then printed the results review with the representatives (based on group dialogues, the planner does not know the exact state of the new program. There are many decisions concerning teaching methods, time used in different environments and changes in actions). The workplace plan was named Version 4. The emergent result was that the new net area would be 6104 net m2. The result was closer to version 3.1 and the group found that approximately 400 m2 could be added to the program to achieve the negotiated target.

Some changes were made instantly, but the meeting ran out of time. It was decided that workplace planning would be continued so that the principal would have meetings in school with teachers and that the Haahtela group and the principal would have telephone-meetings.

11.8.2 Decisions 6.5.-14.5.2003

Core activities:

- Examination areas were needed in the natural science education areas
- Stores for students instruments were added to the music area
- Two normal classrooms were planned to be enlarged in order to add flexibility (32 pupils > 40 pupils)

Supporting activities:

- The vice-principal's room was planned to have a meeting area for 4 people
- The waiting area for pupils would need to be situated close to the teachers working area

11.9 Commitment

The Haahtela team finalized the workplace planning on 14.5.2003. It was named Version 4.2. The net area was 6 574 m2 (usable area + circulation + services area). The school operative managers accepted the workplace planning.

Ari Pennanen of Haahtela team calculated the budget for renovation, extension and maintenance costs assuming that the activities would be located in the present building and site (investment 8 020 000 €, vat 0%). The City Real Estate Organization accepted the budget.

Jyväskylä City Real Estate Organization calculated the rent of spaces (capital + maintenance) and presented it to the City Department of Education. The rent was accepted.

The participants agreed that architectural design could be started. The accepted bill of activities and room schedule are presented in Appendix 1 and 2.

11.10 What happened next ?

What happened next is related to Jyväskylä City's Corporate Real Estate policy and to design steering. These are not the focus of this dissertation and thus are outside the limits of the research. However, by further describing the project's history, workplace planning in relation to other construction activities will be clarified.

11.10.1 Corporate Real Estate Strategy Planning

In Corporate Real Estate the need is observed from the organization's business point of view, rather than from the building's point of view. We now know the working environment needed and the stakeholders are satisfied. Programming is valuable whatever real estate(s) we use. Discussions about a suitable location were initiated.

Jarmo Hulkko from the City Real Estate Organization phoned Ari Pennanen at Haahtela Oy in July and asked for help with real estate strategy. The organization was satisfied with the program, and wanted to test two buildings for Cygnaeus high school purposes

- the existing Cygnaeus school building in the center of Jyväskylä
- another school building named Wilhelmstreet 2

11.10.2 Budgets for Investment and Maintenance

Wilhelmstreet 2 real estate was quite new, it was designed in 1991 as a school for social education. It was about the same size as the present Cygnaeus school. It was in good condition, the room distribution suited Cygnaeus school well. The budget was calculated using the Target Price Method and for investment it was 5,5 million €. The renovation degree was 29 % (cost compared to a similar new building) and a 2 770 m2 extension was needed. It was located slightly further from the city center.

The budget for the present Cygnaeus school building was 8 020 000 €. The renovation degree was 77 % and a 2 300 m2 extension was needed. The real estate was located in the city center.

The budgets for maintenance costs were about the same in both cases.

Wilhelmstreet 2 was cheaper in terms of investment because it was newer and in better condition (especially the hvace-systems).

11.10.3 Discussion about Locations in Jyväskylä City

If Jyväskylä City needed both buildings, it did not matter financially whether the present building or Wilhelmstreet 2 building was used. The financial value of the present building was low because the City had not invested in it in for a long time. If they invested now, they would have to have used more money but this would have increased its financial value. In that case City would have had to decide what location would have better suited Cygnaeus school.

If both buildings were not required one could be sold. In that case it might be easier to sell the present Cygnaeus school real estate. The location was conveniently situated in the center of the city. The value of the building was low, the buyer would probably demolish it and build e.g. apartments. The Wilhelmstreet 2 real estate represented high financial value, but its functional value was high only for the City (private companies do not need schools. A school building's value as an apartment or office is low).

Cygnaeus school wanted to stay in its present convenient location. Potential pupils valued the central location of the school and so the school easily attracted talented pupils. For the school the existing location represented better functional value.

So in that case it would be necessary to decide whether private business or public education would eventually use this prime city center location.

11.10.4 Steering the Design

In August 2003 the City decided that Cygnaeus high school would be located at its present site. They had negotiated with an institute for vocational education and agreed to sell Wilhelmstreet 2 real estate to the institute. Ari Pennanen was asked to steer the design in the sketch design phase in order to ensure that the targets set in workplace planning would be achieved.

The financial target was based on:
- room schedule commitment (appendix 2)
- survey of the existing net area
- commitment to the requirements set on the rooms (internal climate, lighting etc.)
- survey of existing buildings condition
- survey of room sizes needed and existing room sizes

The existing building was smaller the required area, so an extension was needed. It was agreed when budgeting that an extra 10 % provision area for adjusting the room schedule to the existing building would be accepted (it made it possible for the architect to utilize existing structures, e.g. partitions). As a result there were two simple targets for sketch design:
- all spaces in workplace planning were needed
- the extension should not be larger than 2 300 m2 net area.

If those targets could be achieved, an elemental estimate should be done to ensure that the project would remain in budget.

Ari Pennanen and the architect had a meeting before the design was started to

exchange information and to find a strategy for starting design. An example.

- The form of the existing building was of adjacent tower blocks. The functional absence was that the corridors were not connected. Moving horizontally would require first going downstairs, then moving horizontally before going back upstairs again. It was found in the meeting that where connections were lacking, they should be incorporated into the extension. If the corridors were connected inside the existing building, the existing classrooms would be demolished (and the renovation degree would rise).

The architect made several design solutions. The accepted one (by teachers) is presented in appendix 4. The extension net area was 2 291 m2, about the same as the target. It was not a coincidence because that was where the architect aimed. He retained many existing classrooms (and structures). The elemental estimate had not yet been completed (in fall 2003) but there was confidence that the project would remain in budget with this proposal.

11.11 The other Case Studies

Several workplace planning problems were handled using the Workplace Planning Steering Model in 2003-2003. Ph.D. Candidate Michael Whelton from University of California at Berkeley worked in spring 2003 in the Haahtela PM project management group as a researcher and workplace planner. He introduced and analyzed four more Workplace Planning case studies in his dissertation “The Development of Purpose in the Project Definition Phase of Construction Projects. Implications for Project Management” .The research was done an University of California at Berkeley (Whelton 2004). His case study findings have been referred to in the case study analysis of this research. The four case studies are Stadia Polytechnic, Vantaa Police Station, Arcada Polytechnic and Synapsia Rehabilitation Centre.

Stadia Polytechnic

This project encompassed a large set of appraisal studies of operational functions and user activities. The case reveals the capacity of the workplace planning system to manage needs data for large scale facility owners. The case shows how owner strategy personnel require a complete description of the workplace system prior to making a decision on strategic action (Whelton 2004).

Vantaa Police Station

This case study is about the Vantaa Police workspace strategy and project development. Vantaa is a metropolitan area of Helsinki. Vantaa police occupy an old existing building which was identified as functioning poorly. The building had poor technical performance issues and no longer operated effectively to

support service functions. The building was also thought to lack space for activities. Haahtela were employed by a state owned property developer to do workplace planning on the user organizations. At the time of study, the process was iterating through the early planning phases of the Haahtela planning process. The research focused on a strategy meeting where the initial results of the workspace quantification model were presented and feedback and action directives were issued by the client. Haahtela completed an initial appraisal of operations and users. Haahtela presented the state of the system to the owner strategy group. The purpose of the meeting was to develop options for the client based on the existing state of facility needs. The case study represents the strategic views of the owner and how the workplace information supported the development of further study. The case study also reveals how the constraints of the existing structure and site are an integral part of the conversation for action (Whelton 2004).

Arcada Polytechnic

This case study is a workspace planning process for Arcada Polytechnic, a Swedish speaking education institution in Finland. The institution serves the needs of the Swedish speaking community particularly in the Helsinki metropolitan area. Prior to the project the Arcada real estate stock was distributed over Helsinki. The main planning strategy for Arcada was to create a centralized campus area. A centralized campus was seen to create a cohesive identity for the Swedish education community. Haahtela performed the workplace planning process and acted as the main project managers. The case study demonstrates the changes over time with respect to the project purposes. The perspectives or problem frames of the principal stakeholders are described. The case demonstrates how the workspace planning tool is instrumental in guiding the group conversations. The case also reveals how innovative dialogues occurred based on the results of the planning models. The stakeholder network is collaboratively engaged and created innovative means to incorporate emerging needs into their facility plans. The case shows how stakeholders are reliant on the results of the workplace model when basing and making their decisions (Whelton 2004).

The Synapsia Rehabilitation Centre

The Synapsia Rehabilitation Centre case study is about a complex multi-faceted client organization with specialist needs. The project is run by the Käpylä Rehabilitation Centre which in turn is owned by Invalidiliitto ry: the Finnish Association of People with Mobility Disabilities. The project demonstrates the ability of the Haahtela Workplace management system to handle a specialist medical client. The empathic skills of the project manager are particularly important in this case. The project represents a case where the

workplace planner is required to have empathic skills capable of understanding a specialist client with multiple medical and social living needs. The project also demonstrates the existence of a collaborative network at the functional or business level. The project group collaborated with a neighbouring project sharing functional resources in the daily operations of the facilities. This collaboration enabled greater client value. The facility was recently completed and is in full operation (Whelton 2004).

12 CASE STUDY ANALYSIS

12.1 The Aim of the Research and the Theory of Workplace Planning

The aim of this research is to create a steering model for workplace planning decision making. Spatial resource needs can be planned on the basis of the organization's strategic and operational needs, and by using operational measurement units as initial values. The steering model will enable dialogue between strategic and operational bodies of a organization. It will support the common understanding and commitment of these bodies.

In the research the Workplace Planning Theory was determined. It states that a spatial investment in an operation competes for the same recourses as the other investments in the operations. Workplace planning brings spatial investments and values of the spaces into line with the other factors of production. The product of workplace planning is the stakeholders' commitment to the spatial needs of the operations. Commitment to common values can be achieved via iterative steering concepts of social complex systems.

The size of a space is dictated by the operations (transformations) taking place within that space and these operations can be decomposed to sub-processes which are also operations.

Spaces are the scene of a temporal flow of operations and non-use time. The number of spaces is due to the temporal utilization of the spaces.

The principles of the theory seek to evaluate the importance of the spatial investment in an operation in relation to the organization's strategy. These principles criticize the non-use-time of the spaces because non-use-time increases the need for spaces. If waste of unrequired spaces for operations and waste of non-use-time can be reduced, more resources would be available for other investments in operations, spatial or non-spatial.

12.2 Case Study Analysis Objectives

Case studies have been analyzed the following aspects:

1. Case study findings in relation to the Workplace Planning theory

2. Commitment as a product and process
- viewpoint of the stakeholders
- problems in commitment
- achieved commitment

3. The results when using the Workplace Planning Steering Model
- did the stakeholders achieve commitment ?
- identification of spatial needs and their affect on buggeting during workplace planning
- history of the case studies after workplace planning
- stakeholders opinions of the Workplace Planning Steering Model

12.3 Case Study Findings in Relation to the Workplace Planning Theory

12.3.1 Spaces and Geometric Actions; Transformation View

Workplace planning theory states that the size of a space is dictated by the operations taking place within the space. Decision making requires fast feedback concerning that relation. In the workplace planning steering model that feedback is provided by the Workplace Planning Procedure.

In the case of Cygnaeus High School an 11 m2 room for the vice-principal was programmed before the 6.5.2003 meeting. It was agreed that he would need a working place, storage facilities for books etc. and some guests would need to be accommodated in his room. When it emerged after the meeting on 6.5. 03 and after new measurement of the state that there would be resources available, the school decided to allocate resources to the vice-principals to enable him to have four-person meetings in his room (pupil-meetings and colleague-meetings. The need for space was related to the school in the following way (Fig. 30, Fig. 31 and Fig. 32):

SPACE-ACTION REGISTER

Luo tila | Muokkaa tila

Space "Office workplace + seat for guests" includes following actions:

Amount (d): 1 (yleensä tämä on ryhmäkoko)

Circulation param: 3

Action	N-function (swapping)	Dimension function	Shelves	Area
1 x Workplace with adjacent table	n=d	a=6.03	1	6,03
2 x Sitting	n=d*2	a=0.84	1	1,68
12 x Normal shelves	n=d*12	a=0,94/n	5	2,26
1 x Cupboards	n=d*0,6	a=1,3/n	1	0,78
0 x free	n=d*0,24	a=1	1	0,24

Internal circulation 0,01 m²

Usable area: **11,00 m²**

Fig. 30. Vice-principals room before meeting 6.5.2003

SPACE-ACTION REGISTER

Luo tila | Muokkaa tila

Space "Office workplace+4 pers. meeting" includes following actions:

Amount (d): 1 (yleensä tämä on ryhmäkoko)

Circulation param: 3

Action	N-function (swapping)	Dimension function	Shelves	Area
4 x Basic space for work, demanding	n=d*4	a=1.53	1	6,12
0 x free	n=d*0,1	a=1	1	0,10
1 x Workplace with adjacent table	n=d	a=6.03	1	6,03
10 x Normal shelves	n=d*10	a=0,94/n	5	1,88
1 x Cupboards	n=d*0,6	a=1,3/n	1	0,78

Internal circulation 0,09 m²

Usable area: **15,00 m²**

Fig. 31. Vice-principals room after meeting 6.5.2003

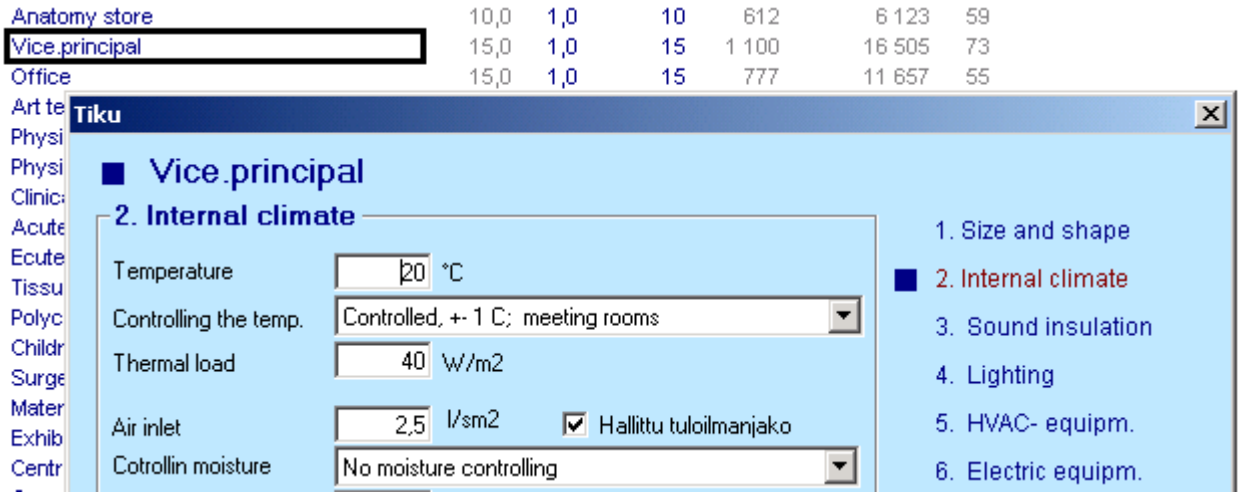


Fig. 32. Financial modeling with the Target Price Method

This is a simple example of the use of the Workplace Planning Procedure's actions register. The spatial needs are not described by drawings but in an operative way: "we allocate resources to enable the vice principal to have four-person meetings". The responsibility for that decision is described as feedback: we need 4 a m2 larger room. By using the Target Price Method (Haatela & Kiiras 2003) we can add more information to the feedback: "we have to invest 3 100 € more (vat 0%) and maintenance costs will rise to 140 euros/year (not including capital interest)".

There is much of evidence that previous actions can be designed within 11 m2 and if a meeting area is added it is possible to design it within 15 m2 (e.g. Duffy et al 1976, p. 91…95). In practice the designed spaces distribute on both sides of those values but 15 m2 is definitely within the distribution area, in the possible area. The designers have been able to design all the case studies within the programmed net volume and all the activities programmed have been achieved. If the individual spaces are studied, some of them are larger than programmed, some of them are smaller. The present classification of actions is described in chapter 10.5.6. If other actions are required, they are determined together with the customer based on other standards or benchmarking measurements.

This method of presentation is very fast, the changing driver is operational (possibility of holding the meetings) and it is quantifiable (four persons). It would be more informative to also provide a graphic illustration, and

sometimes this is in fact also used in workplace planning steering. In this simple case there are graphic standards already available. But most of the rooms are not repetitive. Graphic descriptions would require a lot of architect design and this would be too slow for steering purposes. In the case of Cygnaeus School, the principal also wanted visual descriptions. In further development it would be wise to link visual objects to the Workplace Planning Procedure's operational dimensioning.

Space is not an area strictly outlined by partitions. It is an area where an operation takes place. It has been worthwhile considering rooms, like laboratory hall, church hall, assembly hall, sport hall etc. as operative spaces. As an example Vuosaari Lutheran Church Ceremonies activities are described below as operational areas for decision making. All the other operations apart from events after mass will be held in the same room. Vuosaari church workplace planning was made in fall 2003, and the hall was committed to be designed in this way (Fig. 33). The percentages on the right are temporal utilization degrees of the operational spaces.

CORE ACTIVITIES

Chuch ceremonies (7,0 services)

Spaces

Church assembly hall, 350 pers	1	Pcs	342,6	342,6	27%
side-altar, 30 pers	1	Pcs	25,7	25,7	12%
Chorus, 30 pers	1	Pcs	16,3	16,3	6%
Organ and grand piano	1	Pcs	15,1	15,1	27%
Sacristy, 1 pc	1	Pcs	22,2	22,2	
Events after mass (family events etc.), 200 pers	1	Pcs	291,3	291,3	10%

Usable area:	713,3 m²
Circulation area	
-delivery:	53,5 m²
-sections:	38,3 m²
Services area:	40,3 m²
Net area total:	**845,4 m²**

Fig. 33. Vuosaari church operational spaces for ceremonies.

12.3.2 Workplaces and Use of Time; Flow View

The Workplace Planning Theory states that spaces are a scene of temporal flow of operations and non-use time. The number of spaces is due to the temporal utilization of the spaces.

In the case of Arcada Polytechnic the health sector labs were deemed to be in poor utilization as shown in Table. 3 (Whelton 2004).

anatomy and physiology	60 m^2	5 %
music	70 m^2	24 %
drama	70 m^2	23 %
physical examination	260 m^2	20 %
exercising	60 m^2	4 %
clinical treatment	60 m^2	22 %
polyclinic treatment	50 m^2	8 %
maternity ward teaching	24 m^2	15 %
gymnasium	300 m^2	6 %

Table 3. Arcada Activity (select) Utilization Results

The health sector wanted nine labs as shown above. The utilization degree of anatomy and psychology (5 %) means that if the door of the lab was opened randomly at the observation time determined by the customer (36 weeks a year, five days a week, eight hours a day), then on five occasions there would be occupancy and on ninety-five occasions it would be empty. It was agreed that the utilization degree should not be bigger than 75 % in order to enable flexible time schedule programming. If the 75 % degree were exceeded, another room would be needed. The flow expression of the determined state of the three labs is shown in Fig. 34.

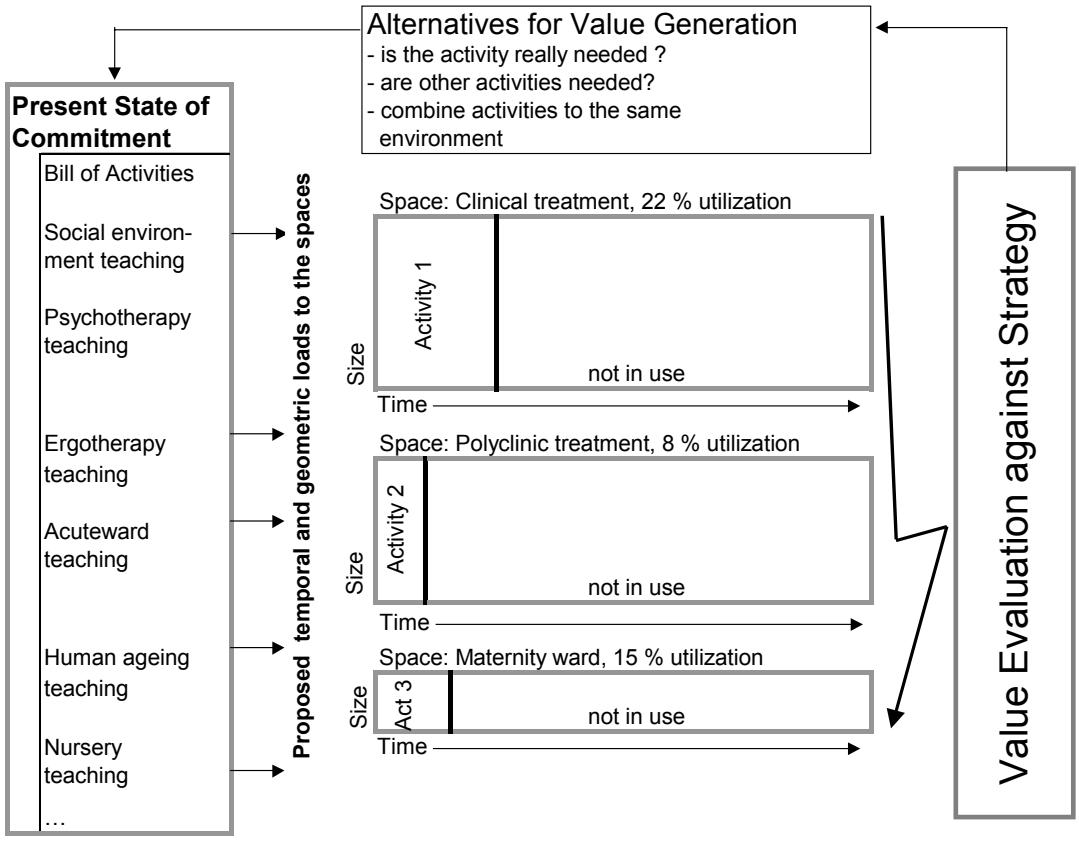


Fig. 34. Flow expression of labs in Arcada polytechnic. The clinical treatment lab, The polyclinic treatment lab and the maternity ward lab need altogether 134 m2 space.

According to the Workplace Planning Procedure the clinical treatment lab, the polyclinic treatment lab and the maternity ward lab are all in less than 25 % use. This means that a large part of investment in those activities would be redundant.

12.3.3 Workplaces and Value Generation; Transformation-Flow-Value view

The Workplace Planning Theory states that a spatial investment in an operation competes for the same recourses as the other investments in the operations. If waste of unneeded spaces for operations and waste of non-use-time can be reduced, more resources would be available for the other investments in operations, spatial or non-spatial. Workplace planning is a process whereby valuable requirements for workplace production are determined through observing and evaluating the values of stakeholders against the organization's strategy.

In the case of Arcada Polytechnic (see previous chapter) the Haahtela team prepared a measurement of desired activities and workplaces of the faculties in the new campus. The Haahtela team then met with the Arcada Board to make suggestions on lowering building costs (Whelton 2004). The usable area was then 14100 m^2, and estimated building costs were 245 million FM (Finnish Marks). The board informed Haahtela that the building costs should not exceed 200 million Finnish marks including the cost of the car parking facility. That meant that the usable area should not exceed 11 000 m^2 which corresponded to a 22 % reduction in spatial area for the project. Haahtela made proposals to reduce the demand for space by: increasing spatial utilization, reducing the value of the organizational function drivers; and removing functions or activities from the Arcada project. The following proposals, for example, were accepted by operative managers (Whelton 2004):

- Concerning the labs, a new goal of 75 % spatial utilization between 8 to 18hours (7.5 h/day) was set to increase utilization. The former goal was for maximum utilization of 75 % between 8 to 16hours (6 h/day). By increasing the facility operations time, the time strains by functions would be accommodated.
- In order to remove activities from Arcada, the TV-studio work space was omitted (very expensive and in quite low use). An external search by the project team located a TV-studio close by, in a University of Art and Design and Arcada created a facility sharing agreement with them. A smaller multimedia studio was specified in Arcada.
- In healthcare education the workplace planning team started looking for similar environments (actions) among the labs. The clinical treatment, the polyclinic treatment and the maternity ward labs were similar (ward type, people in beds, working at benches, need for water supplies…). Healthcare education areas (ward-type) were planned to be integrated. The actions were re-planned to suit all activities. The room size, (75 m^2, 4 beds, storing capacity, workbenches, rocking chair for maternity ward) were adequate. The activities were combined within that room
- Using the same kind of evaluation, the physical examination and gymnasium were combined
- Many other decisions.

It became apparent that other activities would also increase the need for space. Stakeholder groups in the Arcada community felt they needed a forum for larger community events. Based on initial discussions among the Arcada board and the president, the idea for an auditorium became important. A 300 person auditorium was finally included in the program (Whelton 2004).

These changes were the result of a collaborative user-planner effort in effect to define this environment. The final result was that a 10 900 m^2 usable area was required and the space program was estimated to be within the target budget. Unresolved needs at this time were that the operative managers would like to have, for example, a therapy pool and sacral room. These spaces could not be added if Arcada wanted to maintain budget at this time (it was solved later) (Whelton 2004).

Value generation of workplace planning in shown in fig. 35 concerning some of the health care sector labs. Activities in the Clinical treatment lab, Polyclinic treatment lab and Maternity ward lab were combined within the same Ward-type activities lab. The need for space decreased from 134 m2 to 75 m2. All the activities can still be supported; the utilization degree is 45 %.

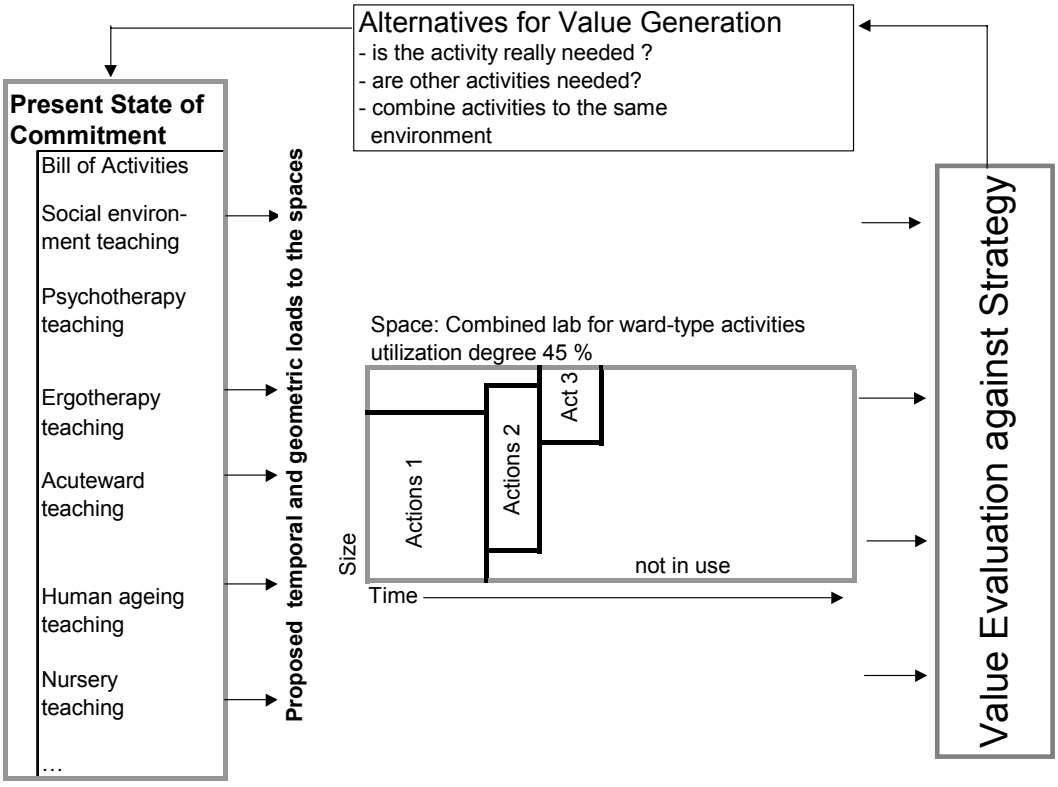


Fig. 35. Example of value generating in workplace planning.

Value generation with workplace planning is evident in all case studies. In the case of Cygnaeus High School this can be seen in the chapters “Discussion with users”, “Discussion with strategic management”, “Strategic project meeting” and “Further dialogues”.

12.3.4 Allocating Resources to Activities

According to the Theory of Workplace Planning, finding alternatives in value generation is an allocation process. Allocation deals with the questions

- can activities be combined within the same environment
- is the activity really needed ? Compared to the others ?
- are other activities needed?

Some examples of those questions in case studies.

Can diverse activities be combined within the same working environment?

- the Arcada Health Care lab problem in the previous chapter is an example of this.

Should actions in the environment be made more flexible so that activities can be combined within the same environment?

- the Arcada Health Care lab problem in the previous chapter is an example of this.

Combine similar Activities of separate Operational Departments.

- In the Vantaa police workplace planning case, several departments (security dep., investigation dep., police jail dep.) had their own interrogation rooms. This led to low utilization. It was decided to create “an interrogation hotel”, an area close to the main entrance and jail where all interrogations would be held. Utilization was improved. The HR manager felt that the new plan was better when reorganizing the staff (Whelton 2004).

Is there somewhere else in the existing environment where the activity can take place?

- In the Arcada case the client had TV-studio activities. It emerged that in the nearby University of Art and Design in Helsinki was a full-scale TV-studio environment. Arcada created a new co-operation with them and a smaller multimedia studio is to be developed in Arcada (Whelton 2004).

Is that activity really needed?

- In the Neuron Research Center case, the sauna activities and half of the accommodation activities were removed to balance need for core activities

Are other activities needed?

- In the Arcada case, the stakeholders (financier) asked for the possibility to support community meeting. An auditorium was added.

12.4 Commitment as a Product

The Theory of Workplace Planning states that a significant product of workplace planning is commitment of the stakeholders to investment in workplaces. Commitment to common values can be achieved via iterative steering concepts of social complex systems.

Decision making requires fast feedback for complex social systems. Modeling methods are needed to show responsibilities that are due to the proposed needs. Participants must obtain information about operations, spaces, sizes, their temporal utilization degrees, investment costs, life cycle costs and possibilities of combining operations within the same spaces.

To support the commitment process of the stakeholders the steering model of workplace planning has to:

- support and stimulate strategic and operative mangers to participate in decision making
- decentralize decision making to the levels where responsibilities are met
- be transparent in terms of information handling
- be fair so that that all information is treated equitably

These characteristics must be constructed in an iterative steering model because committed stakeholders need an opportunity to re-commit towards common goals.

12.4.1 Stakeholders in the Case of Cygnaeus High School

The stakeholders in the case of Cygnaeus School:

- **The City Department of Education** is responsible for the education policy. It coordinates the high school education in the Jyväskylä city area. Economic planning and budgeting among all high schools is under the City Department of Education’s responsibility.
- **The City Real Estate Organization** is responsible of the real estate policy. It coordinates building, renovating, leasing and maintenance of high school property. Jyväskylä City Department of Education pays rent per square meter for using buildings. The Cygnaeus high school renovation/extension project was led by the head of the project managers.
- **High school teachers** carry out education in practice. The staff is led by the principal, vice principal and principal of adult high school education (adult education will be held in the same facility in the evenings). Teachers plan the education under the policy of the City Department of Education.

- **The students' association** represent the students in Cygnaeus high school.

12.4.2 Why did the Stakeholders not Commit to the Common Goals before Workplace Planning ?

In the case of Cygnaeus High School the Haahtela team was asked to do workplace planning because the architectural programming had failed a year ago. Programming actually started in 1997 and was completed in 2002. The programmer finalized a result but it was not accepted. The stakeholders did not commit to the same values.

The selected architectural programmer, specializing in renovations, was commissioned by the city real estate organization. The planning team comprised the city real estate personnel, the school headmaster and the architect. The architectural programmer's working method was close to Problem Seeking, described in chapter 1.2. The city representatives also wanted a visualization (sketches and mass model) for better understanding. Later, the city cost planner prepared the cost estimation. The program consisted of a list of rooms, requirements of the rooms, the existing building condition survey, and the budget for investment.

The program was cancelled, "put on ice". The reasons the stakeholders did not commit to common goals have been noted in the case study (Whelton 2004). The reasons can be classified according to commitment drivers mentioned in the workplace planning theory.

Lack of transparency

- The real estate organization felt that they had a policeman role. They could only say that things were too expensive and could not see how to reduce one need over the other.
- The real estate organization felt that the users did not see that their space was unused.
- The school felt that the city was not very collaborative.
- The real estate organization felt that the school was not very collaborative.
- The real estate organization managers often found themselves at the mercy of the users and the architects (Whelton 2004).

Inability to bring spatial investments and values in to line with other factors of production.

- The city found that the program was too expensive. The investment would raise the rent too much for the City Department of Education. The initial program was seen by the city to waste time and resources
- The real estate organization felt that the programmer had little control over

the budget and wishes.

- The real estate organization felt that the architects normally do not critisize needs, and often lacked knowledge on costs.
- The real estate organization lacked the tools to rationally decide what needs could be included in the program (Whelton 2004).

Inability to support participants decision making

- Teachers felt that they had a strong vision of what they needed. The principal felt that those in the City did not understand the role of the school.
- The city felt that the school's vision looked too far into the future, whereas the principal saw the city department looking too much back at history and what traditional education was.
- The architect doing programming had difficulties making clients decide (Whelton 2004).

12.4.3 Commitment Process in the Cygnaeus School case

An individuals commitment changes continually (see chapter 5.8.2). The individual stakeholders are committed to their various different goals during the initial stage, so there may be conflicts between goals, personnel etc. To find a new target for mutual commitment, new approaches must be identified. Achieving a final commitment of an organization is an iterative process of commitments, withdrawals and new approaches (Fig 36).

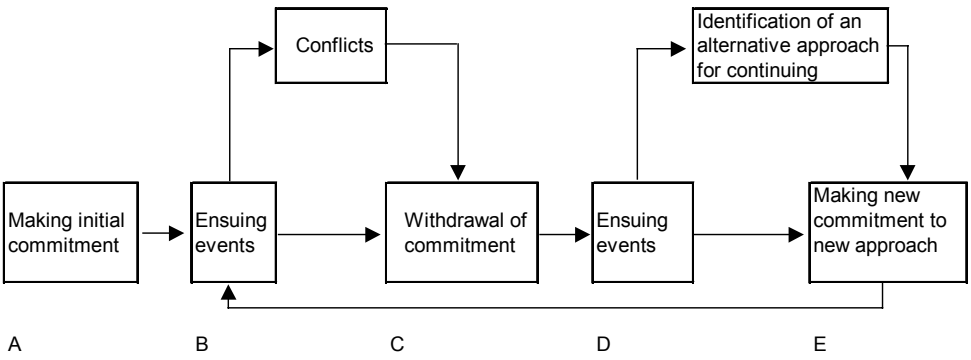


Figure 36. The dynamic commitment model (Newman & Sabherwal 1996)

The stakeholders were initially committed in the Cygnaeus school case;

- teachers were committed to the program that was done before workplace planning
- the Real Estate Department was committed to a certain rent related to the extent of the program. Since the City Department of Education was not willing to pay that much, they were not willing to invest.

- the City Department of Education was committed to treating all the high schools equitably when allocating resources on workplace rent.
- student opinion was not asked for, nor recorded.

During the workplace planning process the school teachers and the real estate department withdrew of their commitment due to ensuing events and looked for alternative approaches to new commitment. The common commitment was eventually found. The City Department of Education stayed in quite a passive role during the process. The students had their first chance to take part in decisions. They committed to the final workplace planning.

The new withdrawals and new commitments occurred as follows (the headings are the same as in the case study):

First discussion with users. Examples of decisions:
- a second music space was allowed
- low utilization of spaces to split groups was not allowed
- commitment to Version 3

Discussions with strategic management. Examples of decisions:
- better utilization of spaces was required
- an alternative program was planned by optimizing low use spaces
- commitment to Version 3.1

Strategic project meeting. Examples of decisions:
- commitment that a target between Versions 3 and 3.1 would be acceptable
- agreement that operative management would have the first option to try to plan activities and workplaces to the goal

Further dialogues
- many decisions and measurements
- commitment to Version 4.2

The commitment
Teachers and students committed to Version 4.2
The Real Estate Department committed to the budget for investment and maintenance
The City Department of Education committed to Version 4.1 as the new learning environment and to the rent of the spaces

12.4.4 Commitment Drivers in the Cygnaeus High School Case

According to the Workplace Planning Theory, to support the commitment process of the stakeholders, the steering model of workplace planning has to:

- support and stimulate strategic and operative mangers to participate in decision making
- decentralize decision making to the levels where responsibilities are met
- be transparent in terms of information handling
- be fair so that that all information is treated equitably

To test if the steering model of the workplace planning method can support mutual commitment, the Cygneaus High School case is analyzed against those factors (all following cases refer to Whelton 2004):

Supporting and stimulating strategic and operative mangers to participate in decision making

- The main idea or vision of the school was that learning does not happen in the class room alone. Different learning environments, and more self-empowerment for students were needed. The main change was to allow students to get information more easily. The teaching role would also be changing, and now more related with mentoring and overseeing. The idea was to decentralize teaching and create a diverse education as the essence of the new vision. This included a variety of new ideas. There would be a new learning environment, but not in the traditional sense of a school facility. It envisioned students spending their spare time in the facility. This created the initiative for a vision of education into the next century.
- The school teachers felt that Haahtela's direct focus on the student as a needs driver was a positive issue, an aspect on which they previously lacked explicit focus. This issue is notable as teachers who serve students, lacked an operational focus for the student and normally approached the problem from their teaching perspective.
- When Haahtela came in, they asked the questions who, when, where, how and what. They found that it was good to formalize the needs of the students and teachers using this process. The school staff were surprised by the initial results from the program model and how the spaces were being used (Whelton 2004).

Decentralizing the decision making to the levels where responsibilities are met

- The school teachers felt that Haahtela's direct focus on the student as a needs driver was a positive issue, an aspect on which they previously lacked explicit focus. This issue is notable as teachers who serve students,

lacked an operational focus for the student and normally approached the problem from their teaching perspective (Whelton 2004).

Being transparent in terms of information handling

- The city project manager felt that the Haahtela system was an effective management tool. The Haahtela methodology acted as a means to communicate with other project participants.
- The city project manager felt that the reliability of the project was increased because ”the client can request everything in this world”, but now they felt that they could trace the origin of the need and resolve it.
- As an education group the school staff themselves began to understand that their needs had to combine themselves with money into a program (Whelton 2004).

Being equitable in information handling

- The architect felt that Haahtela had more control and could hold the client accountable. He pointed out that it is difficult to tell clients that they cannot have what they want. He remarked that: ”the ball is now in the client’s court”. Previously we (the architects) lacked a steering mechanism that Haahtela now provides”. The architects felt their job became easier as they “can start from here” (the program statement) once preliminary discussions were over.
- Overall the school management felt that the process was effective. They felt that Haahtela had more control over the process.
- At the end of the workplace planning process, the teachers felt that the city and other stakeholders had a good understanding of their needs. ”Everybody sees something they need in the program and the city looks for costs. The city now has a rationale to work with” (Whelton 2004).

12.5 The Results when Using The Workplace Planning Steering Model

12.5.1 Generation of Spatial Needs and Financial Resources during Workplace Planning

In the Stadia case and in the Vantaa City Police case workplace planning is not yet complete. In the Stadia case the customer wanted to widen workplace planning to include also other programs apart from technical education (health care, social programs etc.). They re-scheduled the work so that the first functions to come to the new campus would be Building construction and Mechanical engineering. The other technical programs would be next and finally other programs would be planned in relation to existing spaces and the new campus. The work started in spring 2003 and it will last until summer 2004. Vantaa City Police are waiting for the comments of one important

stakeholder, namely the Ministry of the Interior, and its decision on the financing schedule among Finnish police organizations. Vantaa City Police and the Senate Property Services have stated that they are committed to the result.

Other case studies have been completed (February 2004). Synapsia has been constructed and it has been in use for almost a year. Cygnaeus High school is in the design phase. The sketch design solution has been accepted (see appendix 4). Arcada polytechnic is in the construction phase. The analysis of the generation of the needs for space and financial resources has been studied using the Synapsia, Arcada and Cygnaeus cases. One case is added, Jyväskylä polytechnic. It has not been described earlier and it will be used only in this chapter. Jyväskylä polytechnic workplace planning consisted of technical, economical, pedagogical and clothing design programs (about 20 000 net m2). This case has been added because there is a parallel program to compare with. There was an architectural program made half a year earlier, but the stakeholders also wanted to use the steering model of workplace planning (they had heard the results in the Arcada case). Jyväskylä polytechnic is in the design phase, sketch solutions have been accepted.

In all cases using the workplace planning steering model value generation has led to lower use of spaces and to lower budgets. The activities important to the customer have been produced during value generation. In two cases (Jyväskylä polytechnic and Cygnaeus high school) there were independent conditions to test. In both cases parallel programming had been already done by traditional methods.

The Cygnaeus high school case (Whelton 2004):

- In the High school case the net area (usable + corridors + services) needed was 8 150 m2 in traditional programming. After workplace planning the need was 6 504 m2 without loss of activities. The reduction was 20 %.
- means: activities were re-allocated (in relation to spaces) and there was better utilization.

The Jyväskylä polytechnic case

- In the Jyväskylä Polytechnic case the initial accepted program budget was 25 000 000 €. The budget after workplace planning was 20 700 000 €. Activities were increased during the process. Cost reduction was 17 %.
- means: low utilization spaces were made more flexible to allow more activities, better utilization, new strategy to centralize language teaching in the campus area

The Arcada case (Whelton 2004):

- The initial need was 14 100 usable m2 and the budget was 40 million euros including a car parking building (not in the usable area), site investment and financing costs.
- At the Arcada board meeting 11.6.2001, the board stated that 34 million euros could be allocated
- At the beginning of 2002 version 5d was accepted. The size was 11 020 m2 usable area. The reduction was 22 %.
- means: low utilization spaces were made more flexible to allow more activities, better utilization, renting time of nearby TV-studio, new collaboration with other firms

The case of Synapsia rehabilitation centre (Whelton 2004)

- first planning 15.10.1998 was 9 030 usable m2. The board did not accept it because it led to too expensive patient places
- the accepted version 26.3.1999 was 7 673 usable m2. The reduction was 15 %.
- means: some activity drivers were lowered, e.g. occupational therapy workplaces from 10 to 6. Meeting areas were removed from social workers' rooms. Collaboration with the Neuron research center and private magnetic photo/ tomography service provider.

In the Synapsia case the first financial estimates were not available. But if the needs for financial resources are approximately in relation to use of space, the generation of the building costs during the workplace planning can be represented as in Table 4.

The Case	Cost reduction during Workplace Planning
Cygnaeus High School	20 %
Jyväskylä Polytechnic	17 %
Arcada	22 %
Synapsia	15 %
In average	18,5 %

Table 4. Generation of building costs during workplace planning

12.5.2 History of the Case Studies after Workplace Planning

Synapsia

Synapsia has been constructed and it has been in use since spring 2002. The architect was able to design the spaces within the workplace planning space program and it was constructed within the budget. The building was cited as "one of the best pieces of Finnish architecture during 1998…2002" (Building Information 2002). Post occupancy evaluation has not been done in a measurable way. The managing doctor has confirmed that the building works in the manner envisioned during planning.

Arcada

Arcada is in construction phase in january 2004. The architect was able to design the spaces within the workplace planning space program and within the budget. The construction will be completed in june 2004. According to the completed procurements Arcada will be constructed within the budget.

Cygnaeus High School

Cygnaeus High School is in the design phase. The architect was able to design the sketches within the workplace planning space program. The teachers have approved the sketches. The cost estimation has not been done yet.

Jyväskylä Polytechnic

Jyväskylä Polytechnic is in the design phase. The architect was able to design the sketches within the workplace planning space program. The teachers have approved the sketches. The cost estimation has been done from the sketches and it is within the budget.

12.5.3 Stakeholders' Opinions of the Workplace Planning Steering Model

12.5.3.1 Strategic Management

Cygnaeus high school

The city project manager felt that the Haahtela system was an effective management tool. The manager did acknowledge that he did not know how the tool actually operates, but from initial results, the tools have gained his trust. The Haahtela methodology acted as a means to communicate with other project participants. The reliability of the project is increased because "the client can request everything in this world", but now they feel that they can trace the origin of the need and resolve it (Whelton 2004).

Arcada
The real estate manager felt that the Haahtela Planning system helped to build trust through the constant dialogues. Constant reference to the Haahtela information supported reliable decision making (Whelton 2004).

A risk in the Haahtela system is that people should not copy present activities into future building programs. There is a risk that groups may simply copy what they do today. The real estate manager thinks that there is an enormous potential to create changes at the outset of a project and needs should always be questioned and challenged through the course of project definition (Whelton 2004).

For a complex project with many stakeholders, each with their own decision processes, it is vital to have a transparent system. The client leadership demands that the budget is followed, but then the operations have many needs. Ideally client operations, client leadership, the designer and Haahtela are all important to have in the group forum (Whelton 2004).

The demands on the Haahtela management system are high as the workplace planner needs prior knowledge of client business practice or services. In certain instances, the real estate manager would like more examples of new trends or benchmarks in the industry (Whelton 2004).

Synapsia
Overall the managing doctor felt that there was active communication between Haahtela and the group. The general feeling was that there was active listening and open communication on all parts. The viewpoints of the staff were very important to consider (Whelton 2004).

12.5.3.2 Operative Management and Users

Cygnaeus High School
Overall the school management felt that the process was effective. They felt that Haahtela took more control of the process. Haahtela's direct focus on the student as a needs driver was a positive issue, an aspect on which they previously lacked explicit focus (Whelton 2004).

Articulating the vision and putting it into operation was difficult for the school staff. The principal would have preferred to work visually and at times all these numbers were difficult to work with and base decisions on. The vice principal felt that school groups had initial difficulties to get Haahtela to understand them and they to understand the Haahtela working language. They felt that perhaps Haahtela could articulate their system better (Whelton 2004).

Synapsia

The empathic nature of Haahtela's inquiry process was regarded as highly valued in the process of understanding the functional workplace. The shared understanding was established around many specialists communicating about a problem (Whelton 2004).

12.5.3.3 Architects

Cygnaeus High School

The architect felt that there was value in the Haahtela management system. Haahtela has more control and can hold the client accountable. He made the point that it is difficult to tell clients that they cannot have what they want. "Previously we (the architects) lacked a steering mechanism that Haahtela now provides". The architects felt their job becomes easier as they "can start from here" (the program statement) once preliminary discussions are over. Balancing cost with a good design solution is the potential benefit this management system provides (Whelton 2004).

Should the future design development contradict the final program statement, then the architects would feel it necessary to voice the issues. If they get new value generating ideas, they will offer it to the group, explore new special ideas, and perhaps generate new value (Whelton 2004).

Arcada

In architectural practice there is an element of artistic skill which merges with technical and management knowledge. For the project architect, Haahtela is an excellent co-driver. The need for a common language is based on common purpose. There is absolute transparency in the Haahtela process. They do not use information against us (Whelton 2004).

The Haahtela planning system may not define certain limitations on space and so the spatial layout concepts require further analysis by the architect (Whelton 2004).

He perceived that the Haahtela model is based primarily on hard values. It is a basic ground or platform for the designer to play on, but as the main designer of the building, he feels he needs to understand the feelings and soft values of the client (Whelton 2004).

13 SUMMARY

13.1 The Aim of the Research

The aim of this research is to create a steering model for workplace planning decision making. Spatial resource needs will be planned on the basis of the organization's strategic and operational needs, and by using operational measurement units as initial values. The steering model will enable dialogue between strategic and operational bodies of an organization. It will support the common understanding and commitment of these bodies, and it will produce new information and new viewpoints which when reviewed will assist the company in strategic workplace planning and project definition.

For this purpose
- the workplace planning theory was constructed
- the steering model for workplace planning was planned
- methods needed for workplace planning were created and determined

13.2 The Workplace Planning Theory

The workplace planning theory links workplace planning to production, not only construction production but also to the organization’s general strategy. The theory consists of a concept, principles and methodologies.

13.2.1 The Concept

A spatial investment in an operation competes for the same resources as the other investments in the operations. Workplace planning brings spatial investments and the values of the spaces into line with the other factors of production.

Workplace planning is a process where valuable requirements for workplace production are determined through observing and evaluating the values of stakeholders against the organization’s strategy. The product of workplace planning is the stakeholders’ commitment to the spatial needs of the operations.

The size of a space is determined by the operations (transformations) taking place within that space. Spaces are a scene of temporal flow of operations and non-use time. The number of spaces is determined by the temporal utilization of the spaces.

13.2.2 Principles

Spatial investments in operations that are not needed for the organization's strategy are not value-adding and therefore are waste. The operations' time is value adding and the non-use time is non-value adding with regard to the strategy. Non-value adding time is waste and should be reduced or eliminated. Temporal waste can be eliminated in the following ways:

- Combine diverse activities within the same working environment.
- Plan spaces to be flexible enough to support diverse activities.
- Combine similar activities of separate operational departments within same environment

If waste of unneeded spaces for operations and waste of non-use-time can be reduced, more resources will be available for the other investments in operations, spatial or non-spatial.

The value of a spatial investment in an operation can not be predicted based on the initial information, as decision making is linked to complex economical-technical-social systems. Commitment to common values can be achieved via iterative steering concepts of social complex systems.

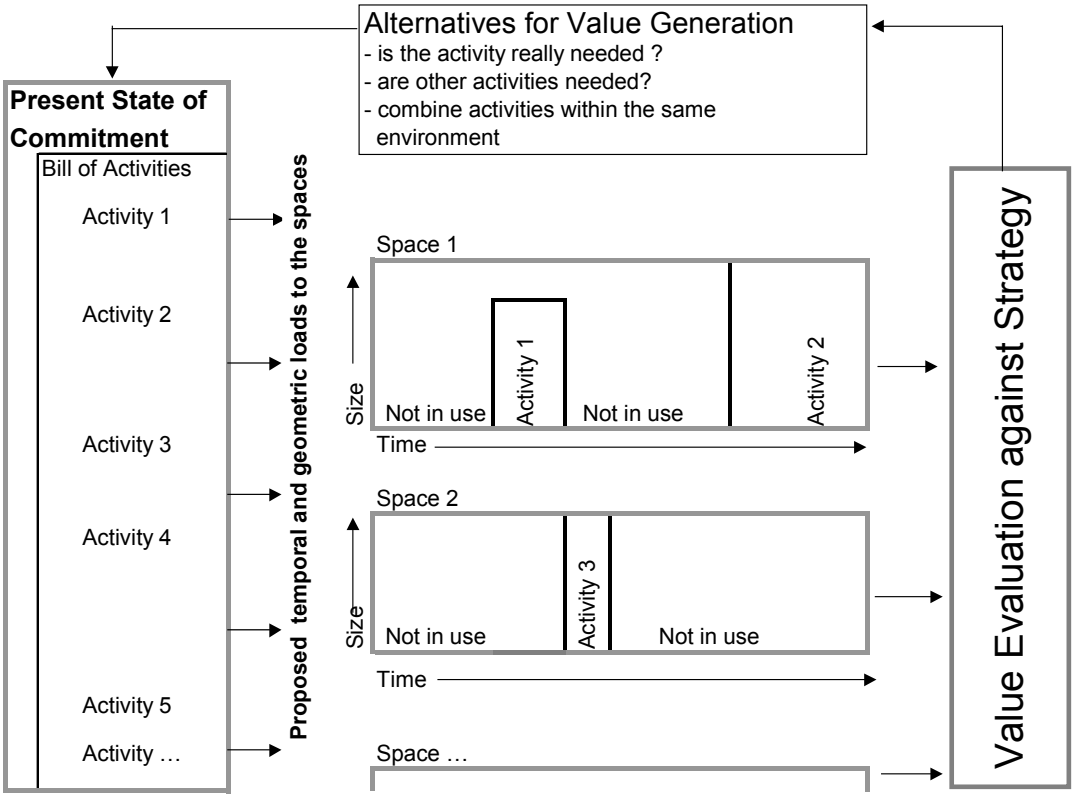


Fig. 37. Workplaces as a transformation/ flow /value generation process.

13.2.3 Methods

A significant product of workplace planning is commitment of the stakeholders concerning investment in workplaces. Decision making for commitment requires fast feedback in a complex social system. Modeling methods are needed to show responsibilities that are due to the proposed needs. Participants must have information on operations, spaces, sizes, their temporal utilization degrees, investment costs, life cycle costs and possibilities to of combining operations within the same spaces.

To support the commitment process of the stakeholders the steering model of workplace planning must:

- support and stimulate strategic and operative mangers to participate in decision making
- decentralize the decision making to the levels where responsibilities are met
- be transparent in terms of information handling
- be fair so that that everybody's all information is treated equitably

13.3 The Steering Model for Workplace Planning

13.3.1 General

The developed steering model is a mode of action that systemizes the organization's decision making actions, produced information and specific methods in accordance with workplace planning theory. By following this model different types of organizations are able to manage their workplace needs on the basis of strategic and operational information.

The Steering model consist of methods that help in the current-state measurement. For cost modeling it uses the Target Price Method (Haahtela & Kiiras). For space dimensioning of the activities a new mathematical model, the Workplace Planning Procedure has been created as part of this research.

13.3.2 The Structure of the Steering Model

The steering process aims to develop spatial quantification of the workplace environment. The process is supported by a management steering model and the workplace planning procedure. The workplace processes are managed by the workplace planner through a dialogue between the facility owner

organization that include strategic and operational management, and facility users.

Workplace planning is linked to a very complex system; a set of goals, a wide range of needs, different viewpoints of the owner and user etc. Even though in strategic workplace management there is no right answer, there are certain limitations on decision making that can not be exceeded. The most important points are economic and temporal limitations. The steering model is based on feedback-loop control where the feedback is a description of the current or desired state (use of resources) due to the client's needs and values (Fig. 38). The model identifies disturbance in the system as the variety of needs and interests based on changes occurring in the work environment. What is controlled is the organization defining its spatial requirements. The outcome is a set of needs and solutions to satisfy those requirements.

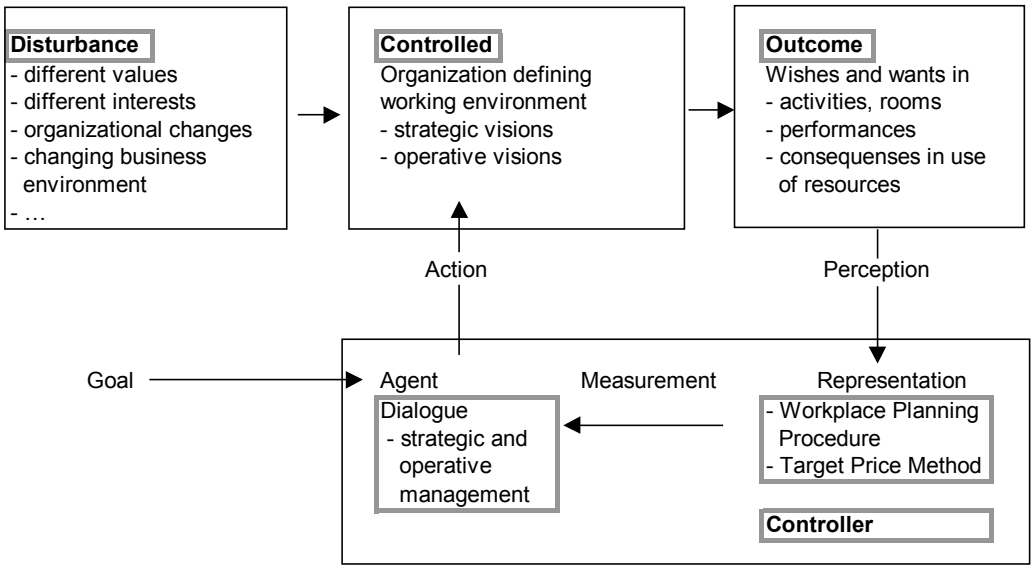


Fig. 38. Closed loop control adjusted to workplace management

The Controller is formed by the dialogue process that is supported by a representation of the present state of the controlled system. The states of the workplace requirements are measured by first defining a list of user functions and activities with the users and operations management. The workplace planner then defines the temporal and geometric requirements of the facility operations. This leads to a definition of the working environment which includes room schedules, performances, details of the potential use and temporal utilization degrees. The solutions are budgeted and associated costs are traced the back to activities through the use of activity-based cost

management.

The workplace planner identifies four primary stakeholder groups in the project definition environment: owner strategy, owner operations management, facility users and external agents. These stakeholder groups inform the workplace planning process.

The owner strategy group consists of personnel that have overall responsibility for workplace planning strategy. This group comprises a board of directors that have a vested interest in understanding the importance of building facilities in relation to the overall goals of the organization. The operations management group may consist of personnel that have responsibility for designing and operating organizational functions and activities. They are normally responsible for ensuring that the facility supports their functions.

The user groups consist of personnel that actually use the facility workplaces. They are concerned that the facilities have the necessary capability to allow them to perform their actions. Finally external agents may consist of personnel that have knowledge or influence enough to provide information on the state of owner functions or facility performance. They may include design and regulation specialists, or specialists in owner functions.

Once the workplace planner has presented the workplace measurements, the facility owner develops an understanding of the present or desired state of the system; i.e., what kind of working environment the owner groups need and value, and what the subsequent consequences will be to their resources. The information presentation allows transparency in that the client stakeholder can trace organizational activities to their origin.

Typically during the process, stakeholders reflect on their needs and propose new methods which can reshape the organization’s activities and improve their work practices. The workplace planner and project management as controllers are aware of the new goals and then steer the process to search for solutions to reach the new targets. Additional changes can be added to the workplace planning model to create new learning. The process reaches a conclusion once there is group consensus that the desired state has been reached.

13.3.3 The Workplace Planning Procedure

Wide applicability of the workplace planning procedure requires a theory of spatial requirements, which adequately describes the variability in the usage of space. The horizontal geometric quantification can be made accurately with

the help of the following factors (Pennanen 1999):

- the total volume of the functional sector
- the activity bill programmed for the sector
- the time strain of activities and targets for the use of time in the space
- the geometry of the people working and the objects to be placed in the space
- legislation, instructions, norms.

The quantification of space determines the quantity of a single space category and the required floor area to perform a function. The space quantification model begins by describing the organization's function that takes place within the space. The modeling procedure uses operations-based accounting to associate functions with the organizational goal or product. These functions are both core functions and supporting functions that enable the organization to achieve its goals.

Table 5 illustrates the nature of the quantitative model. Consider an education institution that operates in a teaching facility. The volume for the sector is the number of students learning in the facility. This serves as the driver for determining service levels for the learning space. The Activity bill is a description of the core and supporting activities that are employed to ensure that the organizational goal is fulfilled. The core and supporting function take form in operations; e.g., teaching and research functions. These operations occupy a space or a part of a space for a unit of time. The time strain on a teaching classroom may be two hours per class. The space may have a number of classes scheduled during a specified operating period. An expected level of efficiency for the space affects the quantity of spaces and the flexibility of functions requiring the use of the space. The operating degree specifies how flexible the space needs to be. Low operating degrees provide good flexibility but require extra spaces to accommodate the strain. Functions are defined in appropriate hierarchies to define activities and actions occurring in the space area or volume. A student may require $1m^2$ of study space to perform his/her actions. Regulatory specifications are included in this model as necessary. These regulations may incorporate minimum circulation dimensions.

Quantification Variable	Description	Example of Education Institution
The total volume of the sector.	No. Of Customers or Products. Floor space per group size.	Two hundred design students.
The activity bill programmed for the sector.	Core Services. Supporting Services.	Teaching & Research. Administrative activities. Dining.
The temporal strain of functions and goals for the use of time in the space i.e. operating degree.	Temporal Strain. Operating Degree.	Teaching Design Theory 2 hours per class, three times a day equals a 6 hr temporal strain on the classroom. If the teaching class has a 50% operating degree, then 4 hours are available. Another classroom will be required.
The people working and the geometrics of the objects to be placed in the space.	Each function requires space expressed as a performance result.	Lecturer requires 10sq. Meters of lecture area. Students require standard seating and 1sq. meter workspace.
Regulations.	Regulatory society defines the quantification of space.	A basketball court have certain dimensions

Table 5. Space Quantification Example

The quantification model is automated in a web-based application, which supports the workplace planner in defining the workplace environment. Activities demand space due to their functional load. The load might lead to low utilization of a space. The combining procedure seeks similar spaces with low use. It suggests that activities could be combined within the same environment within the target utilization. The optimizing procedure identifies different sized (different group size) spaces which are similar in terms of actions. It suggests that if there are both large and small spaces needed with low utilization, the large one will be needed and the smaller activity can take place there.

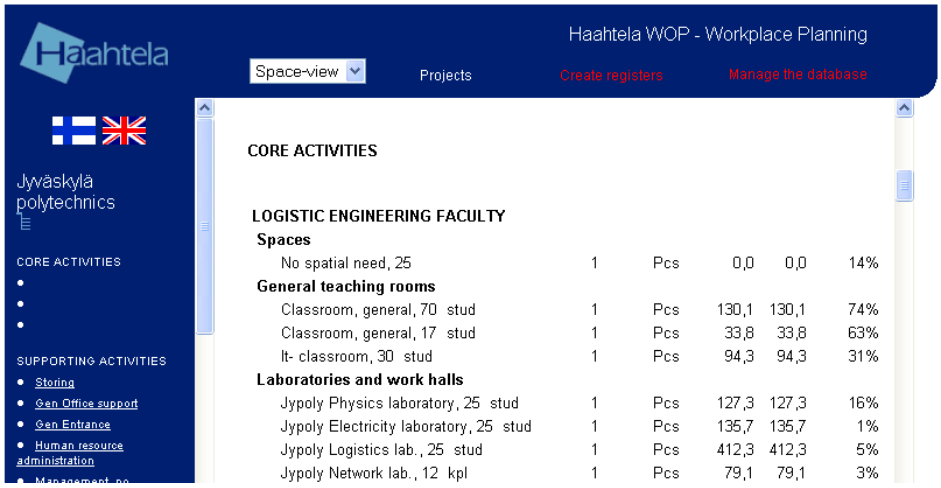


Fig. 39. Logistics engineering laboratories' realized utilization degrees are low. Few courses (activities) demand that resource and even then only for a few weeks at a time. The load is low compared with the possibility of using spaces.

13.4 The Workplace Steering Model in Practical Use

The Workplace Planning Steering Model has been tested in five cases. One of them, Cygnaeus High School is described in this research. The others are introduced in M. Whelton's research "The Development of Purpose in the Project Definition Phase of Construction – Implications for Project Management", done at the University of California at Berkeley (Whelton 2004).

13.5 Value generation

13.5.1 The Principles of the Workplace Planning Theory in Case Studies

The Workplace Planning Theory states that a spatial investment in an operation competes for the same recourses as the other investments in the operations. If waste of unneeded spaces for operations and waste of non-use-time can be reduced, more resources will be available to the other investments for operations, spatial or non-spatial. Seeking for alternatives in value generation is an allocation process. Allocation deal with the questions

- can activities be combined within the same environment?
- is the activity really needed ? Compared to the others ?
- are other activities necessary?

There are many examples in the case studies of various types of allocations during value generation. An example of combining activities within the same

environment is the case of Arcada Health Care Labs. The health sector wanted a clinical treatment lab, a polyclinic treatment lab and a maternity ward lab, which would all be in very low use according to the Workplace Planning Procedure feedback. Much of the investment would have been wasted, as there would have been a great deal of temporal waste. The flow expression of the determined state of the three labs is shown in Fig. 40.

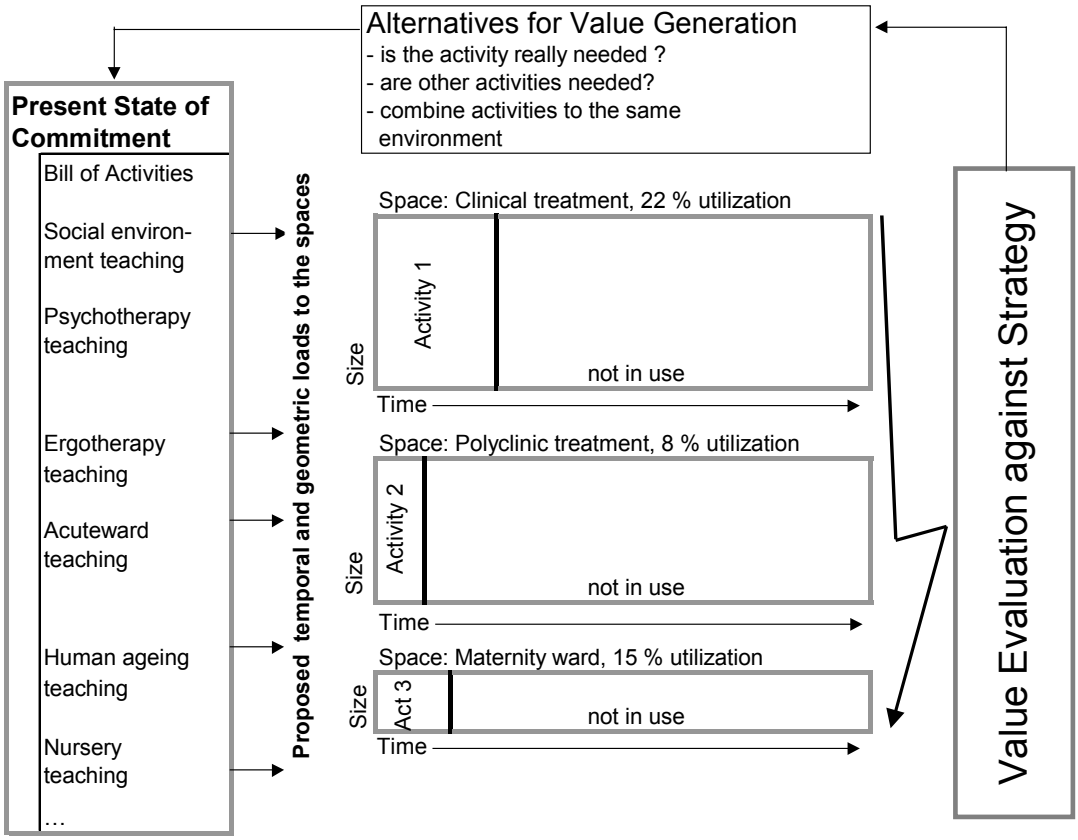


Fig. 40 Flow expression of labs in Arcada polytechnic. The clinical treatment lab, the polyclinic treatment lab and the maternity ward lab require altogether 134 m2 of space.

The workplace planning team started to look for similar environments (actions) among the labs. The clinical treatment, polyclinic treatment and maternity ward labs were similar (ward type, people in beds, working at benches, need of for water supplies…). Ward type activities were combined within the same environment. The actions were re-planned to suit all activities. The room sizes, (75 m^2, 4 beds, storing capacity, workbenches, rocking chair for maternity ward) were adequate. The activities were combined within that room

Value generation of workplace planning is shown in Fig. 41 concerning some of the health care sector labs. Activities in the clinical treatment lab, polyclinic

treatment lab and maternity ward lab were combined within the same Ward-type activities lab. The need for space decreased from 134 m2 to 75 m2. All the activities can still be supported; the utilization degree is 45 %.

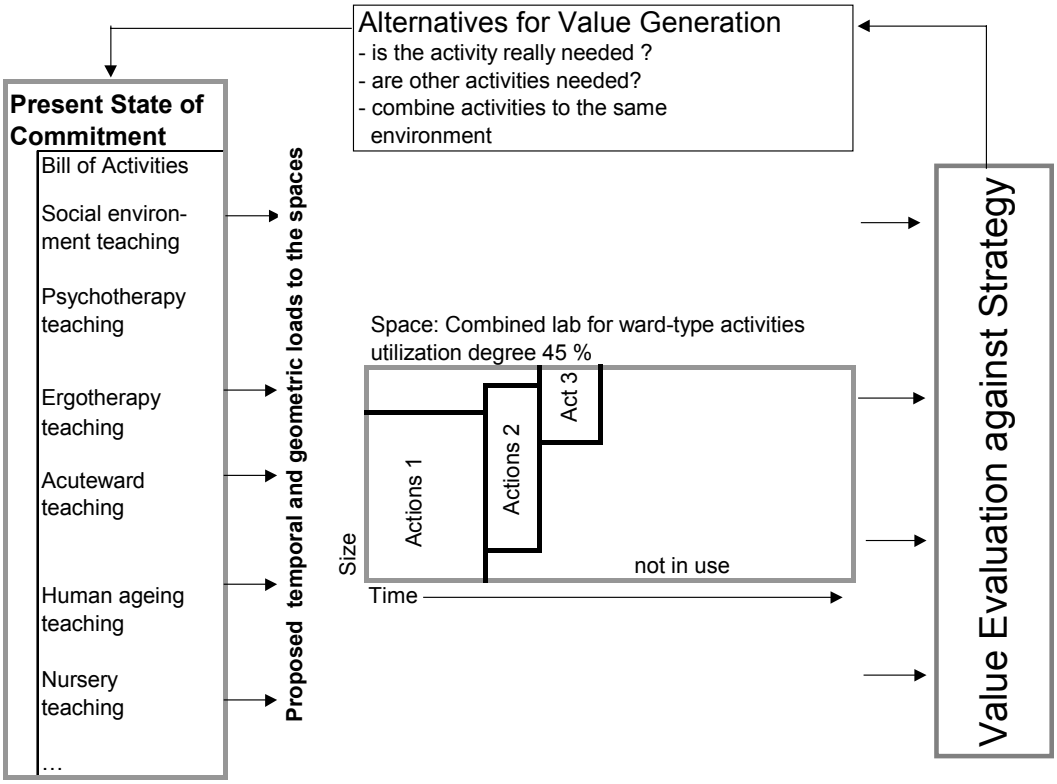


Fig. 41. Example of value generating in workplace planning.

The building costs have been reduced in all cases when allocating resources to activities (even though it has not been always the aim of the workplace planner). In the case studies the Workplace Planning Steering Model has reduced waste.

13.5.2 Stakeholders Commitment to Common Goals

An individuals commitment changes continually. Stakeholders must be able to withdraw from initial and isolated commitment and think about mutual interest again. Affective commitment (Meyer & Allen 1997) to common goals can be supported by:

- collaboration; supporting and stimulating strategic and operative mangers to participate in decision making
- decentralizing the decision making to the levels where responsibilities are met

- being transparent in terms of information handling
- treating all information equitably

Two cases of the five cases are still in progress as of January 2004. All the other cases have been completed and mutual commitment has been achieved. One of them is in the design phase, one is in the construction phase and one is already in use.

Before the workplace planning of Cygnaeus High School there was traditional architectural programming process. It did not lead to commitment and was cancelled, mainly because of a lack of the above factors. The Workplace Planning Steering Model led to mutual commitment in a few months. The steering model is collaborative, it supports decision making, it is transparent and stakeholders feel that they can trust in the information that the Steering Model produced.

13.5.3 Affect on Operational and Strategic Behavior

It was stated in the research hypothesis that the workplace planning concept has an effect on strategic and operational decision-making. It has proved to provide the customer with new information and therefore is a basis for decision making in workplace planning (Whelton 2004). The case studies have shown that the workplace planning concept has also affected strategic and operational decision making in the way allowed for by CRE management:

Operational:

- there are many examples where the client has changed its operative behavior. For instance Vantaa Police decided to centralize interrogations in an “interrogation hotel” instead of having them in the investigators’ personal rooms. In almost in all cases in which the client has notably changed his working environment this has affected operational behavior.

Strategic:

- in the Arcada case, physiotherapy activities also required a swimming pool therapy environment. In the very early stages workplace planning proved that those activities would be too expensive to be financed. Because of a lack of time the activities were removed and the design was started. Meanwhile a collaborative partner was sought. After a year the partner was found; the Folkhälsan institute announced that they were ready to invest in therapy pool activities in Arcada if they could use it for their service purposes. Workplace planning was started with them and in a month the therapy pool was successfully added in the production design stage (Whelton 2004).

- in the Arcada case it emerged that automotive assembly activities were too expensive in the Helsinki city area. The activity was relocated. Design was carried out without that activity. Later the private Bilia Automotive company was founded to collaborate. Bilia committed to pay rent for 5 years in return for getting part of the service hall in their use. Prakticum is getting a value generating rent price. Bilia is also sponsoring equipment. Bilia see themselves as keeping in touch with talented students. Sharing of resources will be beneficial to both. The automotive assembly hall will be built on a nearby site (Whelton 2004).
- a notable feature of the Cygnaeus High School case was the user's changing perspective over time as they came to understand, or perhaps better, as they created the real vision for the project. For example, the initial vision of a standard renovation project changed to a vision of student learning in the next century. The Haahtela management system facilitated greater understanding of these emergent interests and included them in the project definition (Whelton 2004).

13.6 Value realization: History of Case Studies after Workplace Planning

The functional value requirements for stakeholders are determined during workplace planning Those values have been realized in all cases by design and construction.

Synapsia (rehabilitation center) has been constructed and it has been in use since spring 2002. The architect was able to design the spaces within the workplace planning space program and it was constructed within the budget. Post occupancy evaluation has not yet been done quantifiably. The managing doctor has remarked that the building works as it was planned.

Arcada is in the construction phase as of January 2004. The architect was able to design the spaces within the workplace planning space program and within the budget. The construction will be completed in June 2004. According to the completed procurements Arcada will be constructed within the budget.

Cygnaeus High School is in the design phase. The architect was able to design the sketches within the workplace planning space program. The teachers have approved the sketches. The cost estimation has not yet been done.

13.7 Workplace Planning Steering Model and Architectural Quality

If project management aimed to minimize price, the result could be poor quality. But very soon when moving to average price production, the correlation between quality and costs becomes very weak. When moving from minimum to reasonable costs the quality can not be assured by allocating more resources to production. A reasonable budget may just as well lead to the best quality as to the poorest of quality. It seems that architectural quality is linked to the creativity and artistry of the design group and how they interpret our culture and it's changes rather than to money. Quality is realized by design, designers and the steering of the design. In the Synapsia case the budget was steered to a reasonable level by the client. The chosen designer has won many architectural competitions in Finland (Hannu Jaakkola). It was difficult to find solutions suited to the requirements and to the financial constrains, and many proposals were dismissed as too expensive. The building was named "one of the best pieces of Finnish architecture during 1998…2002" (Building Information 2002). It is possible to deal with values, money and activities during workplace planning and to create the best architectural quality (see appendix 5 and front page).

13.8 Workplace Planning Steering Model and Generation of Building costs

The generation of the building costs during workplace planning is shown in table 6. The building costs have been reduced in all cases when allocating resources to activities.

The Case	Cost reduction during Workplace Planning
Cygnaeus High School	20 %
Jyväskylä Polytechnic	17 %
Arcada	22 %
Synapsia	15 %
In average	18,5 %

Table 6. Generation of building costs during workplace planning

13.9 Fit for the Use

The Workplace Planning Steering Model effectively supports stakeholder collaboration. The workplace planning system acknowledges that facility owner organizations are complex, and that owner groups often operate in isolation from each other. The management system demonstrates a capability of bringing fragmented owner groups together in a shared forum to discuss their needs and values. The group dialogues communicate primarily through a workplace planning language. The workplace planner facilitates these owner group dialogues where common needs are identified and the means to share resources are identified. The workplace planner manages this process through understanding the operations of the owner groups and then representing their needs in a workplace model. The workplace planner seeks to identify real needs and discount unnecessary desires and wants that cannot be fulfilled with available resources. The iterative problem solving approach is interactive, with the owner groups providing frequent feedback. The group decisions are made explicit and commitment is sought through verbal agreement and documentation (Whelton 2004).

The Workplace Planning Procedure is usable, but it is somewhat awkward to use. Workspace planning language requires an education module for the user and client. Sometimes clients would have preferred to work visually and they found that numbers were difficult to work with and base decisions on.

13.10 Conclusions

The constructed Theory of Workplace Planning is built on the basis of Production Theory's TFV combination (Koskela 2000). The Workplace Planning Theory links workplace planning to production, not only construction production but also to the organization's general strategy.

The Workplace Planning Steering Model fulfills the theory's principles in practice. It supports strategic and operative management's collaboration and mutual commitment forming. It enables reduction of unnecessary investments and thus releases resources for more important operations in the organization's strategy.

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APPENDIX 1 JYVÄSKYLÄ HIGH SCHOOL. BILL OF ACTIVITIES

Project

Cygnaeus-lukio, ver 4.2

Ari Pennanen 14.5.2003

BILL OF ACTIVITIES

Line of activities	Driver	Group size	Unit
Sch High school	650	32	stud
Total	650		stud

Sch High school

CORE ACTIVITIES

Senior high school mandatory courses

Driver: 650,0 (stud)
Group size: 32,0

Activity	Load	Factor	Total load
SH011 Litterature course (650/32 stud)	6 courses	38 h	228 h
SH021 English (650/32 stud)	6 courses	38 h	228 h
SH031 A-swedish (650/32 stud)	0,72 courses	38 h	27,36 h
SH041 B-swedish (650/32 stud)	5 courses	38 h	190 h
SH051 A-french (650/32 stud)	0,42 courses	38 h	15,96 h
SH061 A-deutch (650/32 stud)	1,14 courses	38 h	43,32 h
SH071 Languages, short (650/32 stud)	0 courses	38 h	0 h
SH081 Mathematics (650/32 stud)	8,4 courses	38 h	319,2 h
SH091 Physics (650/32 stud)	1 courses	38 h	38 h
SH101 Chemistry (650/32 stud)	1 courses	38 h	38 h
SH111 Geography (650/32 stud)	2 courses	38 h	76 h
SH121 Biology (650/32 stud)	2 courses	38 h	76 h
SH131 History (650/32 stud)	6 courses	38 h	228 h
SH141 Religion (650/32 stud)	3 courses	38 h	114 h
LU151 Visual Arts (650/32 stud)	2 courses	38 h	76 h
SH161 Music (650/32 stud)	2 courses	38 h	76 h
SH171 Gymnastics (650/32 stud)	2 courses	38 h	76 h
SH181 Health Knowledge (650/32 stud)	1 courses	38 h	38 h
SH191 Philosophy (650/32 stud)	1 courses	38 h	38 h
SH201 Psychology (650/32 stud)	1 courses	38 h	38 h
SH211 Informantion technology (650/32 stud)	0 courses	38 h	0 h

SH221 Other courses (650/32 stud)	0 courses	38 h	0 h
SH231 How to study (650/32 stud)	3 courses	38	114

Senior high school optional courses
Driver: 650,0 (stud)
Group size: 32,0

Activity	Load	Factor	Total load
SH011 Litterature course (650/32 stud)	1,58 courses	38 h	60,04 h
SH021 English (650/32 stud)	2,56 courses	38 h	97,28 h
SH031 A-swedish (650/32 stud)	0,2 courses	38 h	7,6 h
SH041 B-swedish (650/32 stud)	2,08 courses	38 h	79,04 h
SH051 A-french (650/32 stud)	0,1 courses	38 h	3,8 h
SH061 A-deutch (650/32 stud)	0,3 courses	38 h	11,4 h
SH071 Languages, short (650/32 stud)	4,64 courses	38 h	176,32 h
SH082 Mathematics (650/32 stud)	3,9 courses	38 h	148,2 h
SH091 Physics (650/32 stud)	2,84 courses	38 h	107,92 h
SH101 Chemistry (650/32 stud)	1,02 courses	38 h	38,76 h
SH111 Geography (650/32 stud)	0,72 courses	38 h	27,36 h
SH121 Biology (650/32 stud)	1,14 courses	38 h	43,32 h
SH132 History (650/32 stud)	1,6 courses	38 h	60,8 h
SH141 Religion (650/32 stud)	0,52 courses	38 h	19,76 h
LU151 Visual Arts (650/32 stud)	0,4 courses	38 h	15,2 h
SH161 Music (650/32 stud)	1,88 courses	38 h	71,44 h
SH171 Gymnastics (650/32 stud)	1,26 courses	38 h	47,88 h
SH181 Health Knowledge (650/32 stud)	0,14 courses	38 h	5,32 h
SH191 Philosophy (650/32 stud)	0,64 courses	38 h	24,32 h
SH201 Psychology (650/32 stud)	1,78 courses	38 h	67,64 h
SH211 Informantion technology (650/32 stud)	1,28 courses	38 h	48,64 h
SH221 Other courses (650/32 stud)	0,72 courses	38 h	27,36 h

Spontaneous studying
Driver: 650,0 (stud)
Group size: 32,0

Activity	Load	Factor	Total load
SH501 Group studies (650/32 stud)	3 courses	38 h	114 h

SUPPORTING ACTIVITIES

Storing
Driver: 455,0 (shelve m)
Group size: 32,0

Activity	Load	Factor	Total load
Gen Storing teaching material (455/32 shelve m)	1 -	1 -	1 -

Gen Office support
Driver: 52,0 (persons)
Group size: 32,0

Activity	Load	Factor	Total load
Post service (52/32 persons)	1 persons	1 h	1 h
Goods entrance (52 persons)	1 persons	0,1 shelvem	0,1 shelvem
Gen Storing officematerial (52/32 persons)	1 shelve m	0,5 hylly m	0,5 hylly m
Gen Copying (52/32 persons)	40 copies	0,00167 h	0,0668 h
Gen Post delivery fot personel (52/32 persons)	1 persons	1 cupboardm./pers	1 cupboardm./pers
Gen Printers (52/32 persons)	1 persons	0,05 pc	0,05 pc

Gen Entrance
Driver: 162,5 (persons)
Group size: 32,0

Activity	Load	Factor	Total load
Gen Lobby activities (162,5/32 persons)	1 persons	1 -	1 -

Teachers individual work

Driver: 52,0 (teachers)
Group size: 1,0

Activity	Load	Factor	Total load
CsGen Preparing teaching (52 teachers)	1 workdays	1 h	1 h

Gen Storing, nearby
Driver: 156,0 (shelve m)
Group size: 1,0

Activity	Load	Factor	Total load
Gen Storing teaching material (156 shelve m)	1 -	1 -	1 -

Gen Permanent storing, sliding shelves
Driver: 130,0 (shelve m)
Group size: 1,0

Activity	Load	Factor	Total load
Gen Permanent storing (130 shelve m)	1 -	1 -	1 -

Gen Meetings
Driver: 0,2 (meetigs)
Group size: 32,0

Activity	Load	Factor	Total load
Gen Meetings (0,2/32 meetigs)	1 meetings	2 h	2 h
Gen Meetings foyer (0/32 meetigs)	1 -	1 -	1 -

Com computer servers and switchboards
Driver: 2,9 (servers)
Group size: 32,0

Activity	Load	Factor	Total load
Gen Computer servers (2,925/32 servers)	1 servers	1 -	1 -
Gen Computer swicthboards (2,925/32 servers)	0,67 racks	1 -	0,67 -

Headmasters, comprehensive and senior high school
Driver: 2,0 (persons)
Group size: 1,0

			Total

Activity	Load	Factor	load
Personnel in rooms, 4 pers. meetings (0 persons)	1 persons	6	6
Personnel in rooms, 6 pers meeting (1 persons)	1 persons	6	6
Officework in rooms (0 persons)	1 persons	6	6
Personnel in rooms (1 persons)	1 persons	6	6

Welfare officer, psychologist, tutor
Driver: 2,0 (persons)
Group size: 1,0

Activity	Load	Factor	Total load
Personnel in rooms, 4 pers. meetings (2 persons)	1 persons	6	6
Personnel in rooms, 6 pers meeting (0 persons)	1 persons	6	6
Officework in rooms (0 persons)	1 persons	6	6
Personnel in rooms (0 persons)	1 persons	6	6

Chancellery, comprehensive and senior high school
Driver: 1,0 (persons)
Group size: 1,0

Activity	Load	Factor	Total load
Personnel in rooms, 4 pers. meetings (100 persons)	1 persons	1	1
Personnel in rooms, 6 pers meeting (0 persons)	1 persons	6	6
Officework in rooms (0 persons)	1 persons	6	6
Personnel in rooms (1 persons)	1 persons	6	6

Workplace activities, comprehensive and senior high school
Driver: 0,7 (persons)
Group size: 32,0

Activity	Load	Factor	Total load
Personnel in rooms (0/32 persons)	1 persons	6	6
Gen Janitor (0,65 persons)	1 -	6 -	6 -

Library, comprehensive and senior high school

Driver: 13 000,0 (volume)
Group size: 32,0

Activity	Load	Factor	Total load
Library, material process support (2,3842/32 volume)	1 persons	1	1
Reference library (13000/32 volume)	1 volume	0,025	0,025

School Health Care
Driver: 1,0 (nurse)
Group size: 1,0

Activity	Load	Factor	Total load
Waiting school health care (3 nurse)	1	1	1
School health care (1 nurse)	1	1	1

Gen Storing, furniture
Driver: 715,0 (chair)
Group size: 1,0

Activity	Load	Factor	Total load
Gen Storing, furniture (715 chair)	1 -	1	1

SERVICES FOR STAFF

Gen Food and eating
Driver: 585,0 (persons)
Group size: 32,0

Activity	Load	Factor	Total load
Gen Eating in dinig-room (585/32 persons)	1 h	1 h	1 h
Gen Food servery and (585/32 persons)	1 meals	1 -	1 -
Gen Cooking, full service (585/32 persons)	1 meals	1 -	1 -

Gen Sanitary for tenants
Driver: 650,0 (persons)
Group size: 32,0

Activity	Load	Factor	Total load

CsGen Toilets for pupils (650/32 persons)	0,04 persons	1	0,04

Gen Students personal storage
Driver: 650,0 (persons)
Group size: 32,0

Activity	Load	Factor	Total load
Lockers, cupboards (650/32 persons)	0,25 cupboards	1	0,25

Gen Personnel personal storage
Driver: 52,0 (persons)
Group size: 32,0

Activity	Load	Factor	Total load
Lockers, cupboards (52/32 persons)	1 cupboards	1	1

Recreation
Driver: 52,0 (teachers)
Group size: 32,0

Activity	Load	Factor	Total load
CsGen Refreshning for teachers (52/32 teachers)	1 h	1	1

Students union
Driver: 650,0 (students)
Group size: 1,0

Activity	Load	Factor	Total load
Club for pupils, senior high school (650 students)	1 -	1	1

Sch Sanitary for personnel
Driver: 650,0 (persons)
Group size: 32,0

Activity	Load	Factor	Total load
CsGen Toilets for pupils (650/32 persons)	0,1 persons	1	0,1
Com Having a ducsh (26 persons)	1 showers	1 -	1 -
Gen Changing clothes (97,5 persons)	1 persons	1 -	1 -

BUILDING MANAGEMENT

Gen Building maintenance

Driver: 0,0 (m2)
Group size: 32,0

Activity	Load	Factor	Total load
Gen Garbage disposal (/32 m2)	m2	1 -	0 -
Gen Maintenance (/32 m2)	m2	1 -	0 -
Gen Cleaning (/32 m2)	m2	1 -	0 -

Gen Air raid shelter

Driver: 0,0 (gross area)
Group size: 32,0

Activity	Load	Factor	Total load
Gen Vss-S1 air raid shelter by area (0/32 gross area)	1 -	1 -	1 -

APPENDIX 2. JYVÄSKYLÄ HIGH SCHOOL. SPACE SCHEDULE

Project

Cygnaeus-high school, ver 4.2

Ari Pennanen 14.5.2003

ROOM SCHEDULE

Line of activities	Driver	Group size	Unit
Sch Senior high school	650	32	stud
Sch Senior high school	520		stud
Total	1170		stud

	Amount	Unit	Usable area (m²)	m²/Unit	Utilization
CORE ACTIVITIES					
Spontaneous studying / Sch Senior high school (650,0 stud)					
Individual work					
Team work, 19 stud	1	Pcs	31,7	31,7	73%
Team-work/ individual work, computers, 6 stud	1	Pcs	16,3	16,3	73%
	Usable area:		48,0 m²		
Senior high school mandatory courses / Sch Senior high school (650,0 stud)					
Senior high school optional courses / Sch Senior high school (650,0 stud)					
Drawing classroom, 40 stud	1	Pcs	112,7	112,7	23%
Storage for drawing classroom	1	Pcs	14,5	14,5	46%
Darkroom, 5 stud	1	Pcs	7,0	7,0	29%
Music classroom, 40 stud	1	Pcs	113,3	113,3	66%
Music classroom, 20 stud	1	Pcs	62,6	62,6	31%
Storage for music classroom	1	Pcs	37,0	37,0	37%
Clay and design classroom, 11 stud	1	Pcs	22,2	22,2	27%
Drawing teachers´ room, 1 pers	1	Pcs	11,0	11,0	23%
Studio for music classroom	1	Pcs	37,0	37,0	37%
Storage for music instruments	1	Pcs	18,1	18,1	37%
General teaching rooms					
Classroom, general, 40 stud	5	Pcs	365,5	73,1	53%
Classroom, general, 32 stud	13	Pcs	774,8	59,6	60%
Classroom, general, 20 stud	3	Pcs	117,0	39,0	61%
It- classroom, 40 stud	1	Pcs	122,9	122,9	64%
Language laboratory, 40 stud	1	Pcs	119,9	119,9	45%
Team work, 8 stud	2	Pcs	26,7	13,3	58%
Team work, 5 stud	1	Pcs	8,3	8,3	37%
Mediaclassroom, 32 stud	1	Pcs	103,1	103,1	22%
Natural science teaching rooms					
Physics-chemistry store room (Ty 1)	3	Pcs	105,0	35,0	60%
Natural Science classroom (type E) Biol/Geo, 40 stud	1	Pcs	94,8	94,8	53%
Natural Science classroom (type A) Phys/Chem, 40 stud	2	Pcs	252,4	126,2	38%
Sports rooms					
Gymnastics hall	1	Pcs	300,0	300,0	50%
Dressing room, 24 persons	2	Pcs	65,8	32,9	62%
Gymnastics outside school	1	Pcs	0,0	0,0	62%
Dressing room, 14 persons	2	Pcs	28,1	14,1	71%
Storage for gymnastics	1	Pcs	35,0	35,0	62%
Stage, 200 persons	1	Pcs	85,7	85,7	
Gymnastics teachers	2	Pcs	6,0	3,0	62%
Condition halli, 8 users	1	Pcs	41,7	41,7	25%
	Usable area:		3 088,3 m²		

SUPPORTING ACTIVITIES

Storing / Sch Senior high school (700,0 shelve m)

Spaces

Storage room, 700 shelve m	1	Pcs	156,0	156,0	
	Usable area:		156,0	m²	

Gen Office support / Sch Senior high school (52,0 persons)

Spaces

Copy room	3	Pcs	18,0	6,0	14%
Printers and faxs	3	Pcs	4,6	1,5	
Post boxes, 75 persons	1	Pcs	3,4	3,4	
Storage room, 8 shelve m	1	Pcs	1,5	1,5	
Storage room, 26 shelve m	1	Pcs	4,9	4,9	
Storing, see shelves, 5 shelve m	1	Pcs	1,5	1,5	
Material handling, 2	1	Pcs	3,6	3,6	
	Usable area:		37,4	m²	

Gen Entrance / Sch Senior high school (153,0 persons)

Spaces

Public foyer, 153 persons	1	Pcs	144,0	144,0	
Toilet for disabled	2	Pcs	10,0	5,0	
	Usable area:		154,0	m²	

Teachers individual work / Sch Senior high school (70,0 teachers)

Spaces

Office Workplace, temporaty wrk, 70 persons	1	Pcs	230,4	230,4	18%
	Usable area:		230,4	m²	

Gen Storing, nearby / Sch Senior high school (0,0 shelve m)

Usable area:		0,0	m²	

Gen Permanent storing, sliding shelves / Sch Senior high school (260,0 shelve m)

Spaces

Storing, sliding shelves, 260 shelve m	1	Pcs	24,4	24,4

		Usable area:	24,4	m²	

Gen Meetings / Sch Senior high school (0,2 meetigs)

Spaces					
Meetingroom, 12 persons	1	Pcs	25,4	25,4	5%
		Usable area:	25,4	m²	

Com computer servers and switchboards / Sch Senior high school (2,9 servers)

Spaces					
Computer server	3	Pcs	9,0	3,0	
Computer switchboard	2	Pcs	3,0	1,5	
		Usable area:	12,0	m²	

Library, comprehensive and senior high school / Sch Senior high school (13 000,0 volume)

Library, customer process					
Reference library, 406 shelve m	1	Pcs	114,8	114,8	
Library, material process					
Storage room, 7 shelve m	1	Pcs	1,3	1,3	
Material handling, 1	1	Pcs	1,8	1,8	
		Usable area:	117,9	m²	

Workplace activities, comprehensive and senior high school / Sch Senior high school (0,7 persons)

Janitor, telephone central					
Janitor, 1 persons	1	Pcs	11,0	11,0	75%
		Usable area:	11,0	m²	

Headmasters, comprehensive and senior high school / Sch Senior high school (2,0 persons)
Headmasters, comprehensive and senior high school / Sch Senior high school (2,0 persons)

Spaces					
Office workplace+4 pers. meeting	2	Pcs	30,0	15,0	75%
Office workplace + 6 pers. meeting	2	Pcs	40,0	20,0	75%
		Usable area:	70,0	m²	

Welfare officer, psychologist, tutor / Sch Senior high school (3,0 persons)

Spaces					
Office workplace+4 pers. meeting	3	Pcs	45,0	15,0	75%
		Usable area:	45,0	m²	

Chancellery, comprehensive and senior high school / Sch Senior high school (2,0 persons)
Chancellery, comprehensive and senior high school / Sch Senior high school (1,0 persons)

Spaces

Office workplace + seat for guests	3	Pcs	33,0	11,0	75%
Waiting room	1	Pcs	6,4	6,4	
	Usable area:		39,4	m²	

School Health Care / Sch Senior high school (1,0 nurse)

Spaces

Health care room, 1 persons	1	Pcs	22,0	22,0	
Dressing room for personel, 3 persons	1	Pcs	4,7	4,7	
Small laboratory and instrument maintenance, 1 pc	1	Pcs	5,0	5,0	
Waiting room, 3 persons	1	Pcs	3,8	3,8	
	Usable area:		35,5	m²	

Special spaces for adult learnin center / Sch Senior high school (24,0 teachers)

Spaces

Storage in cupboards, 24 cupboards	1	Pcs	15,7	15,7	
Childrens playroom, 12 children	1	Pcs	26,6	26,6	
	Usable area:		42,3	m²	

Gen Storing, furniture / Sch Senior high school (715,0 chair)

Spaces

Storage room, chairs, 715 chairs	1	Pcs	38,6	38,6	
	Usable area:		38,6	m²	

SERVICES FOR STAFF

Gen Food and eating / Sch Senior high school (585,0 persons)

Spaces

Eating area, 260 seats	1	Pcs	332,8	332,8	75%
Dish return, 260 meals	1	Pcs	7,2	7,2	75%
Food cooking and receiving, 585 meals	1	Pcs	55,0	55,0	
Receiving goods, 585 meals	1	Pcs	11,4	11,4	
Waste room for kitchen, 1 shelve m	1	Pcs	5,0	5,0	
Dressing room for personel, 5 persons	1	Pcs	7,8	7,8	
Food delivery , 260 meals	1	Pcs	21,0	21,0	75%
	Usable area:		440,2	m²	

Sch Sanitary for personnel / Sch Senior high school (650,0 persons)

Spaces

Toilet, 7 persons	1	Pcs	14,3	14,3	

Cloak room cupbards, 10 pc	1	Pcs	9,0	9,0	
Com Dusch, 2 showers	1	Pcs	4,7	4,7	
	Usable area:		28,0	m²	

Recreation / Sch Senior high school (52,0 teachers)

Spaces

Canteen for personnel	1	Pcs	79,0	79,0	20%
	Usable area:		79,0	m²	

Gen Sanitary for tenants / Sch Senior high school (650,0 persons)

Spaces

Toilet, 1 persons	26	Pcs	65,0	2,5	
	Usable area:		65,0	m²	

Gen Students personal storage / Sch Senior high school (650,0 persons)

Spaces

Storage in cupboards, 162 cupboards	1	Pcs	121,9	121,9	
, 650 clothes	1	Pcs	42,8	42,8	
	Usable area:		164,7	m²	

Gen Personnel personal storage / Sch Senior high school (52,0 persons)

Spaces

Storage in cupboards, 52 cupboards	1	Pcs	34,9	34,9	
	Usable area:		34,9	m²	

Students union / Sch Senior high school (650,0 students)

Spaces

Student union room, senior high school	1	Pcs	31,0	31,0	
	Usable area:		31,0	m²	

BUILDING MANAGEMENT

Gen Building maintenance / Sch Senior high school (6 135,0 m2)
Gen Building maintenance / Sch Senior high school (128,0 m2)

Spaces

Cleaning central	1	Pcs	10,0	10,0
Cleaning closet	9	Pcs	27,0	3,0
Waste sorting room, 6 263 m2	1	Pcs	17,8	17,8
Hvac-control room	1	Pcs	8,0	8,0

Caretakers room and storage	1	Pcs	13,9	13,9
Dressing room for personel, 8 persons	1	Pcs	12,6	12,6
Garbage bins inside	1	Pcs	1,1	1,1
		Usable area:	90,2	m²

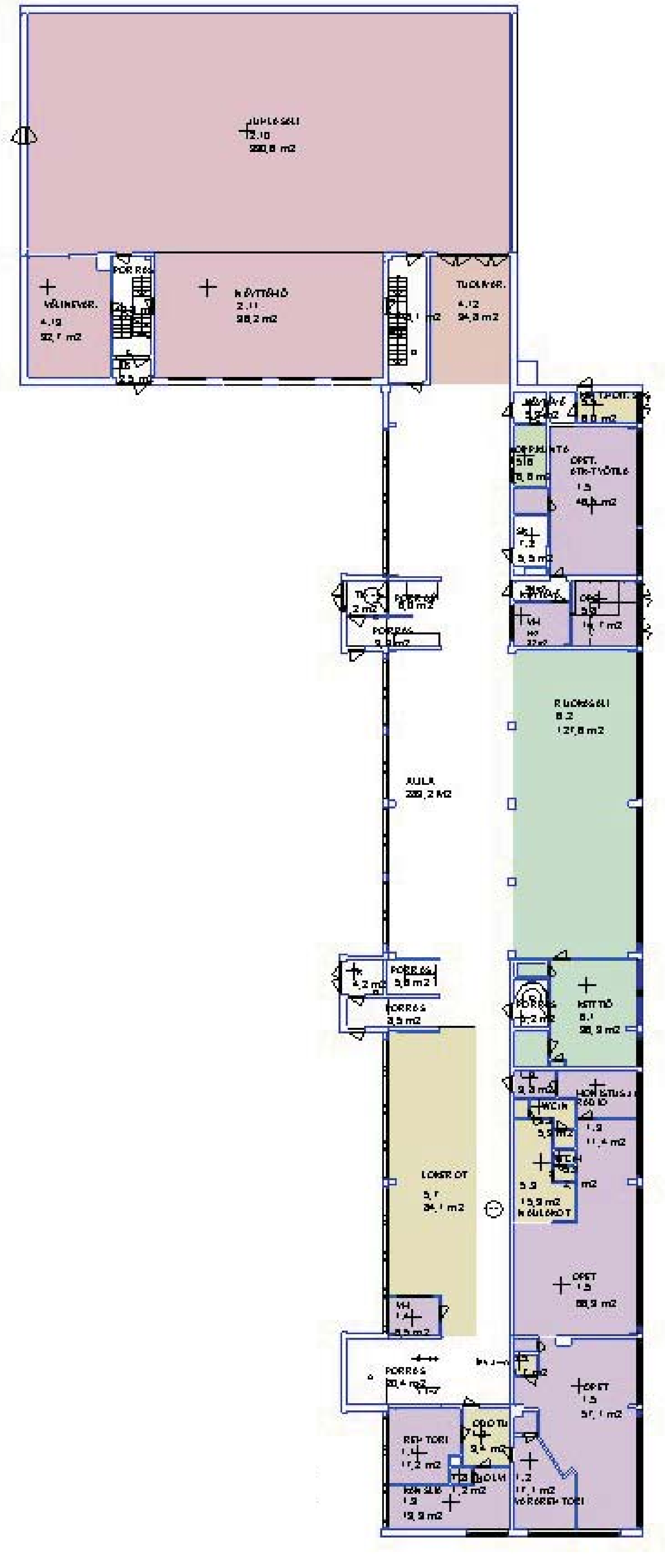
Gen Air raid shelter / Sch Senior high school (6 889,3 gross area)

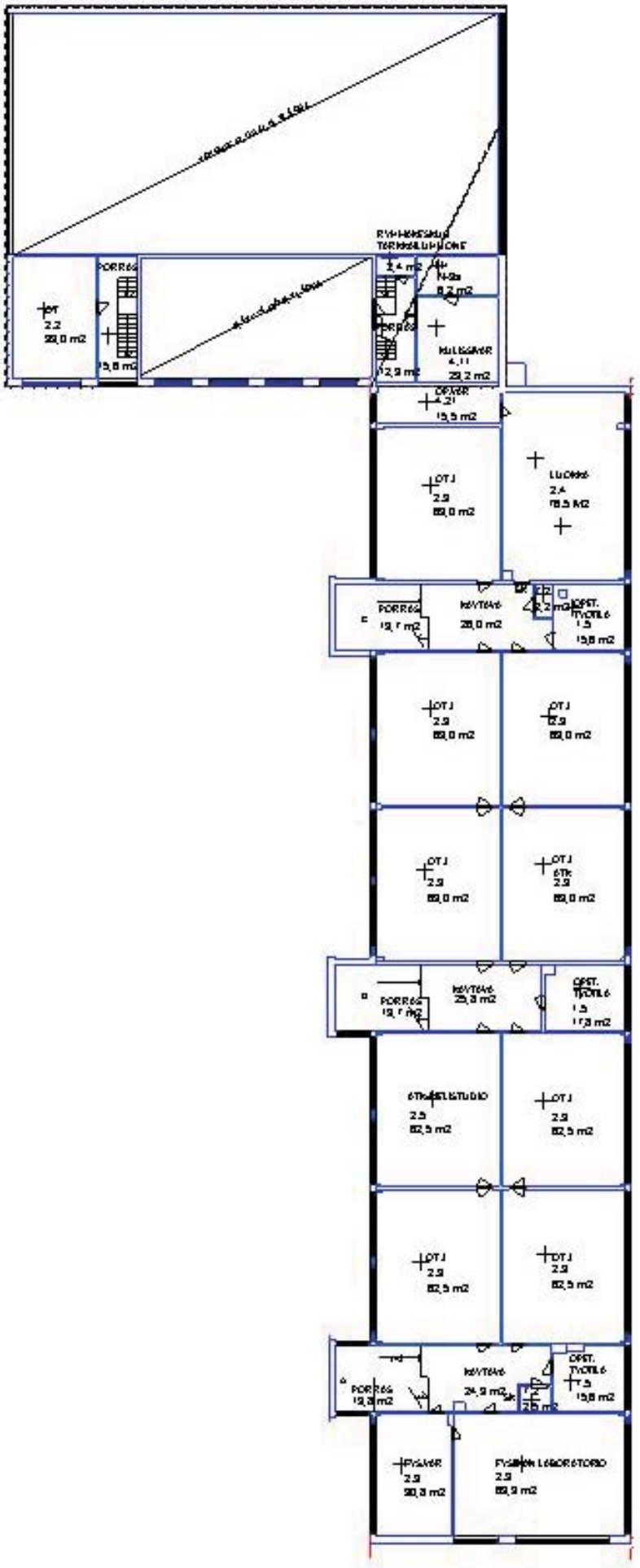
Spaces

Air raid shelters S1, 138 m2 protected area	1	Pcs	165,2	165,2
Air raid shelter useful use	1	Pcs	-110,2	-110,2
		Usable area:	55,0	m²

GRAND TOTAL:	Usable area:	5 164	m²
	Circulation area		
	-delivery:	815	m²
	-sections:	270	m²
	Services area:	326	m²
	Net area total:	**6 574**	**m²**

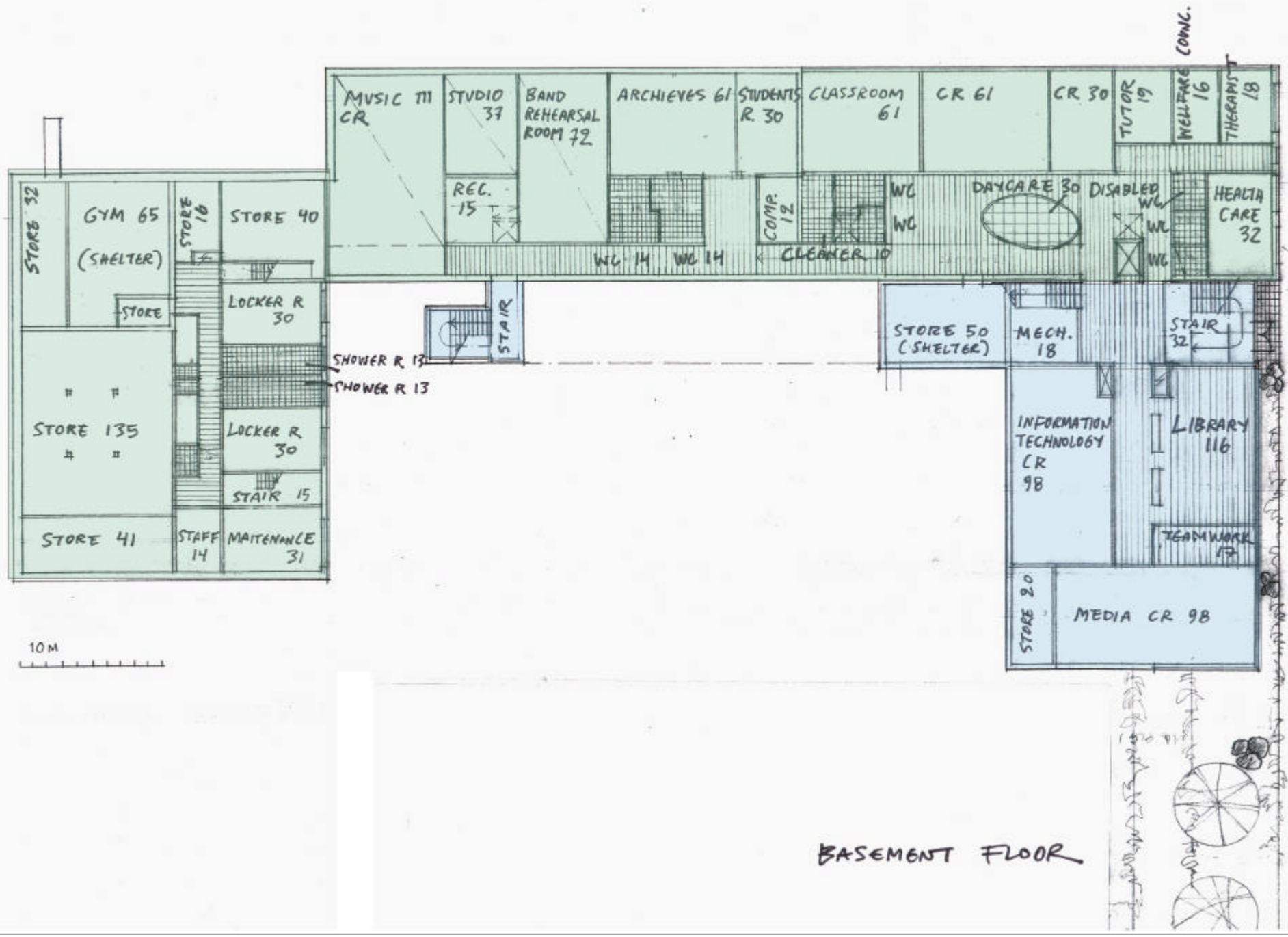
APPENDIX 3. JYVÄSKYLÄ HIGH SCHOOL. GROUND FLOOR AND FIRST FLOOR PLANS BEFORE NEW DESIGN


AULA

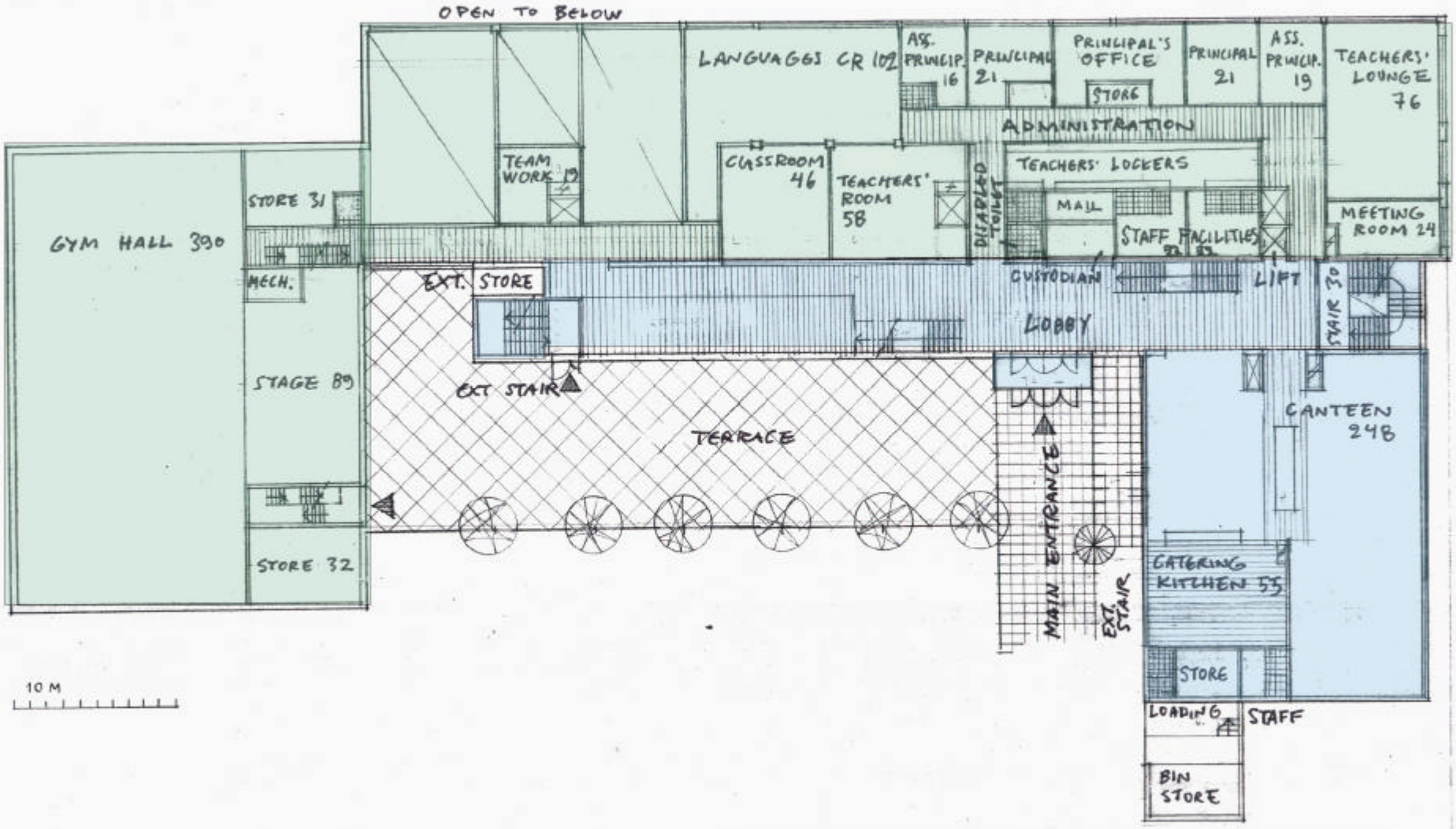


APPENDIX 4. JYVÄSKYLÄ HIGH SCHOOL. ACCEPTED DESIGN SOLUTION AFTER WORKPLACE PLANNING

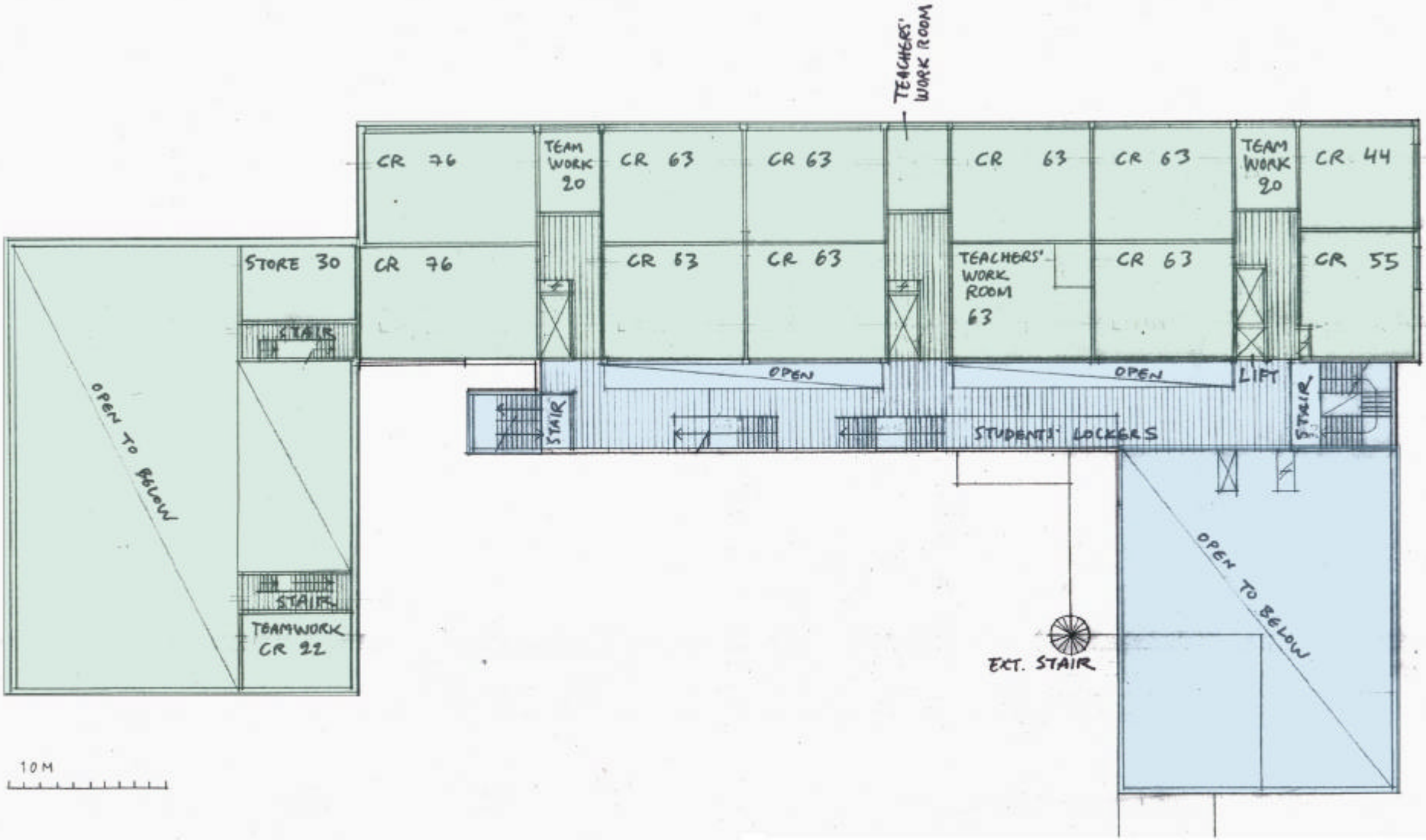
Architect Jussi Kantonen



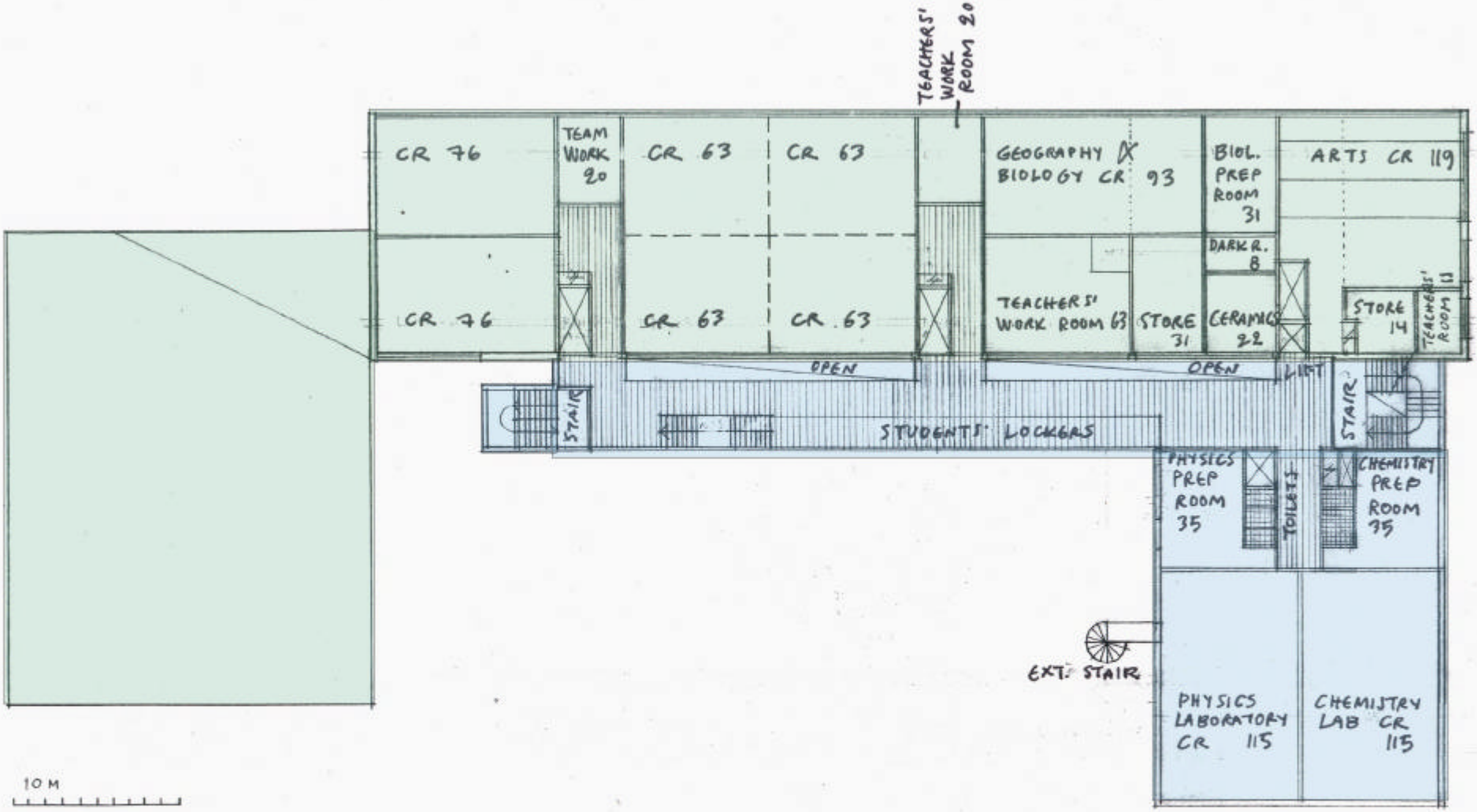
BASEMENT FLOOR



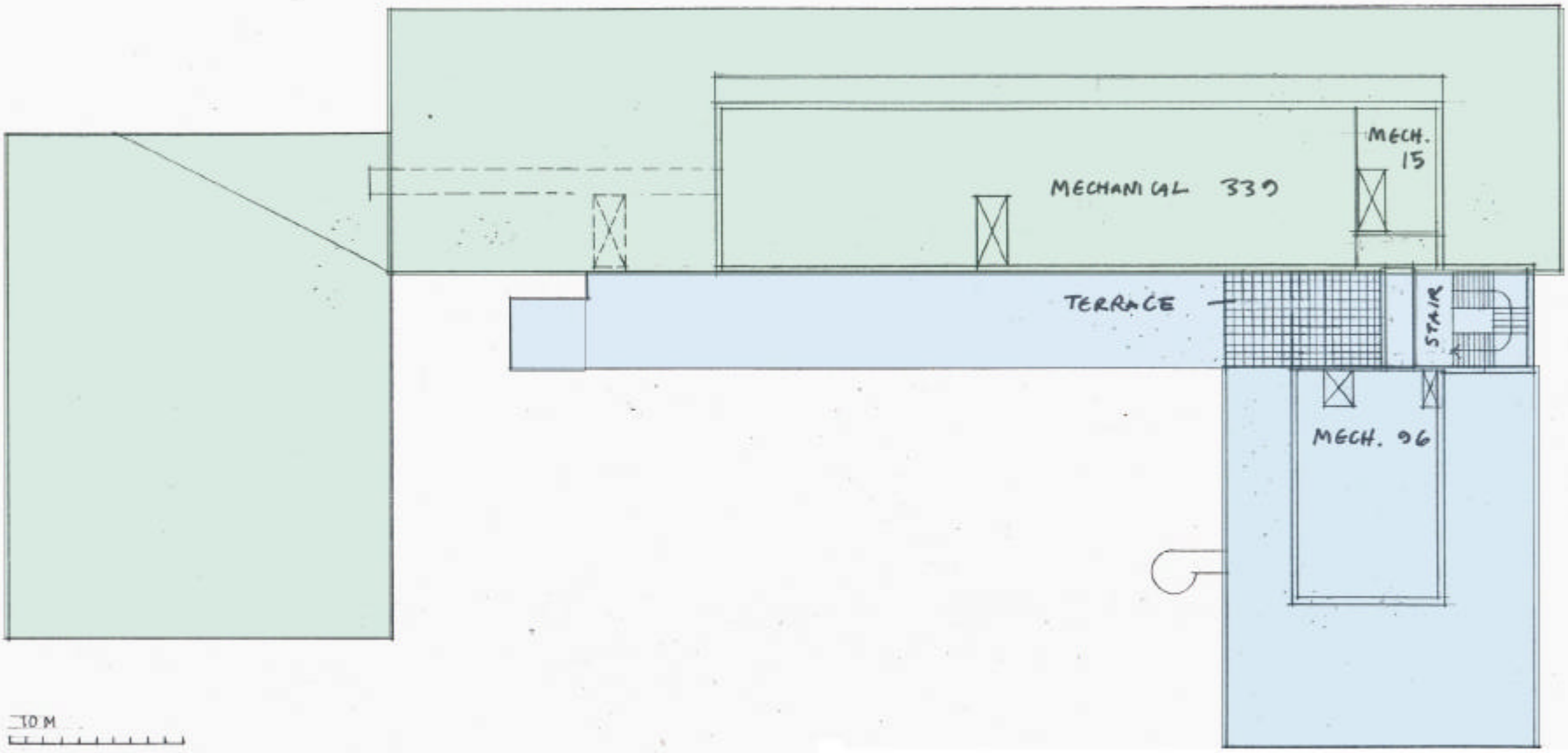
GROUND FLOOR


TEACHERS' WORK ROOM
CR 76
TEAM WORK 20
CR 63
CR 63
CR 63
CR 63
TEAM WORK 20
CR 44
STORE 30
CR 76
CR 63
CR 63
TEACHERS' WORK ROOM 63
CR 63
CR 55
STAIR
OPEN
OPEN
LIFT
STAIR
STAIR
STUDENTS' LOCKERS
OPEN TO BELOW
STAIR
TEAMWORK CR 22
EXT. STAIR
OPEN TO BELOW
10M

FIRST FLOOR



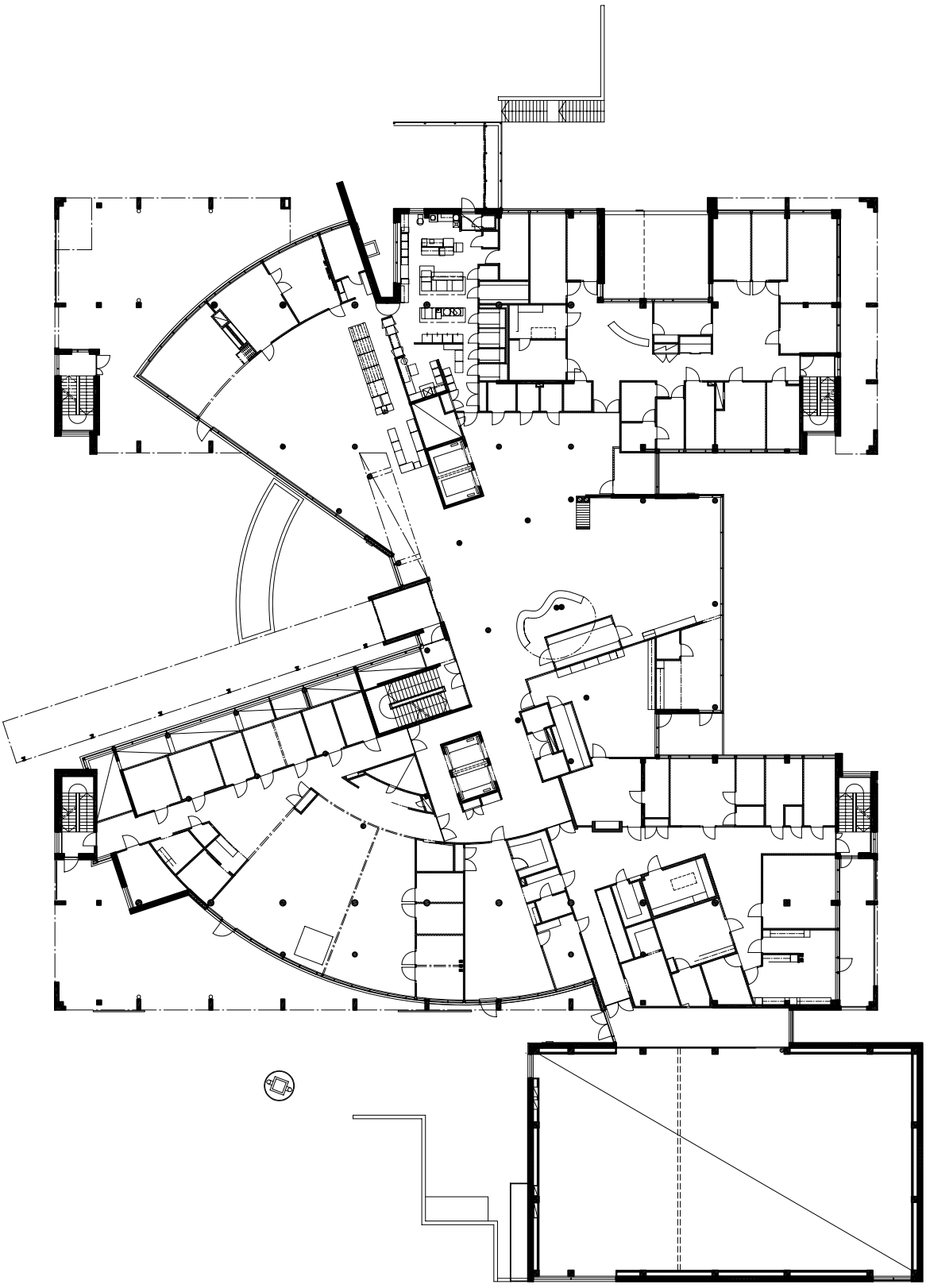
SECOND FLOOR

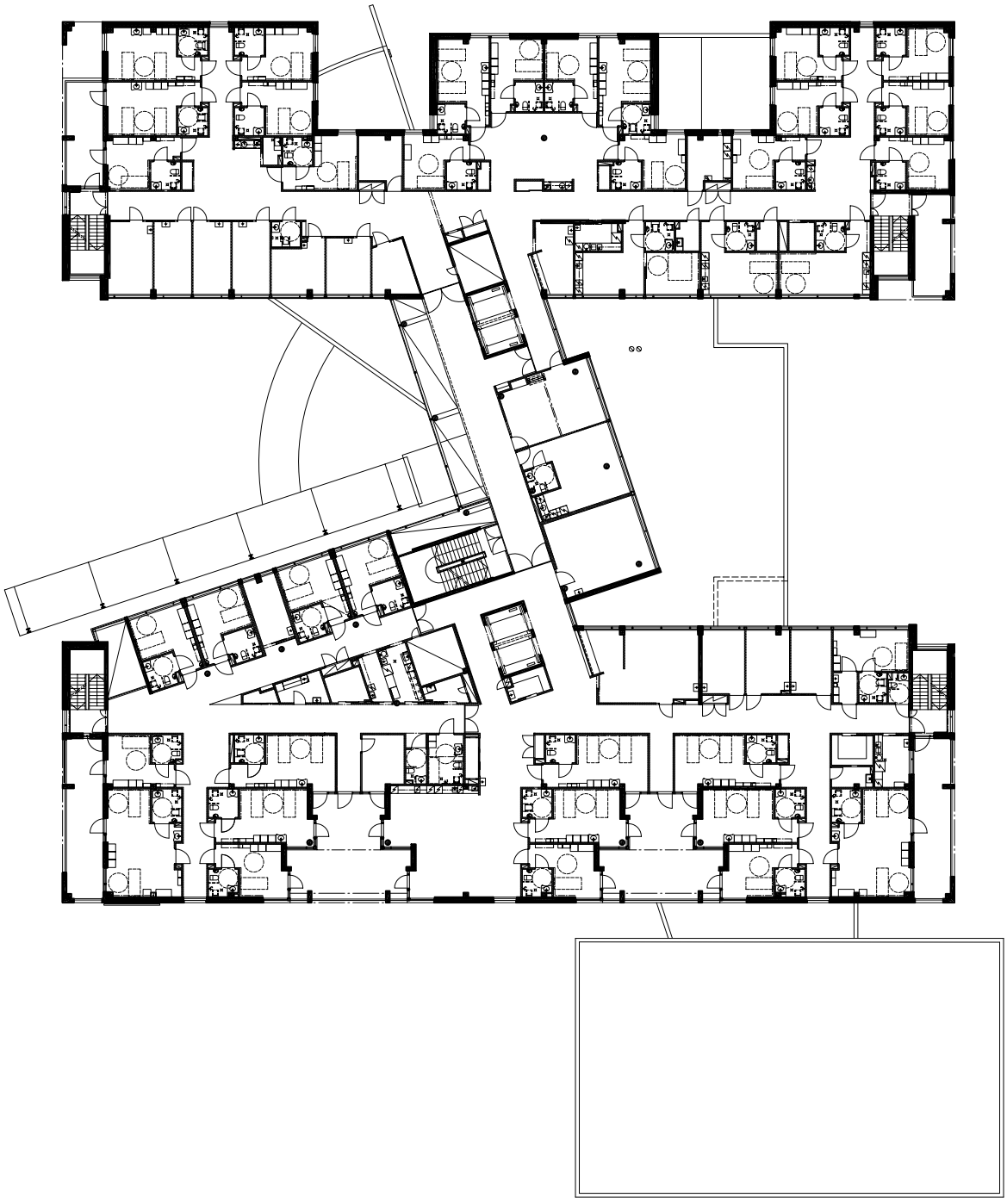


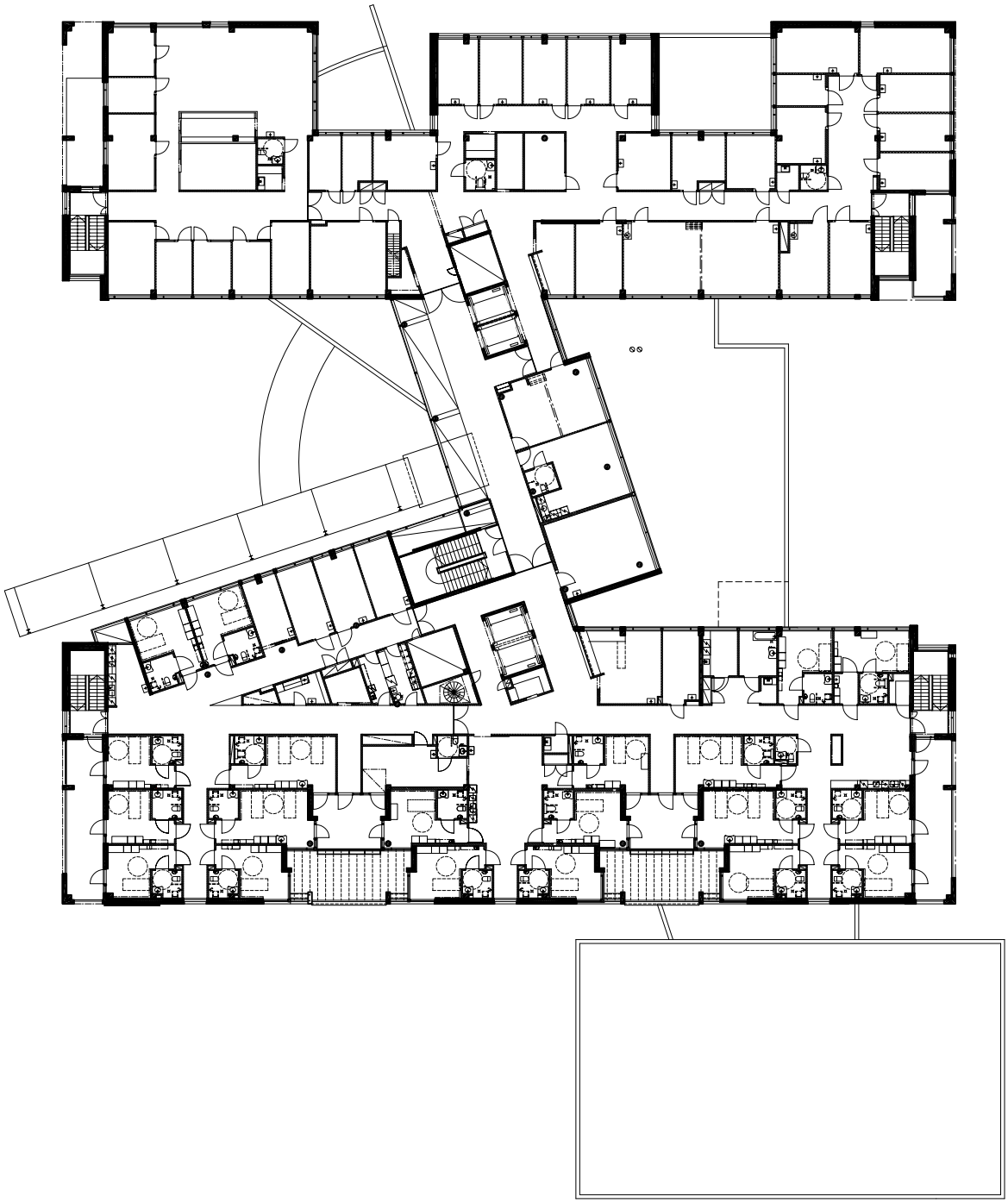
TOP FLOOR/ MECHANICAL

APPENDIX 5. SYNAPSIA REHABILITATION CENTER. GROUND-, FIRST- AND SECOND FROOR PLANS

Architect Hannu Jaakkola







APPENDIX 6. CLASSIFICATION OF ACTIVITIES

User Activity based Workplace Definition as an Instrument for Workplace Management

Classification of Activities

Activity	Driver
Sub-activity	Driver

Core Activities

Core activities are linked to functional sector's core business. They will be classified sector by sector later.

Supporting core activities	Driver
Administration activities	**Adm. empoyees**
Board activities	board members
Management activities	management employees
Accounting activities	accounting employees
Human resources activities	HR employees
Marketing activities	marketing employees
Sales activities	sales employees
Facilities management activities	FM employees
IT support activities	IT support employees
workplace activity	employees
workshop activity	workbench meters
Other supporting core activities	
Office support activities	employees total
mail sending activity	employees
mail delivery activity	employees
office material storing activity	shelve meters
off. material receiving activity	square meters
copying activity	copying machines
fax activity	faxes
Storing (nearby) activities	shelve meters
Permanent storing activities	shelve meters or square meters
Security filing activities	shelve meters
Meeting activities	meetings/ day
Meetings activity	meetings/ day
meetings support activity	meetings/ day
Education activities	educ. hours/ year
Library activities	volumes
aduld lending activity	volumes
children's lending activity	volumes
reference library activity	volumes
music activity	seats
magazines activity	volumes
reading/ workplace activity	workplaces
material processing store activity	volumes
personnel workplaces activity	employees
Computer server activities	server racks
Entrance activities	max. people in entrance
Accommodation activities	beds

Car parking activities	cars
car parking activity	cars
car service activity	service places
car wash activity	wash places

Supporting staff activities

Catering activities	eaters/ shift
food preparation	portions/ shift
food delivery	persons eating
eating	persons eating
personnel dressing activities	seats in dressing room
Personnel break activities	persons at break
personnel cafeteria activity	persons at break
smoking activity	persons smoking
personnel rest activity	
Sanitary activities for staff	employees
Toilets activity	employees
shower/ dressing activity	seats in dressing
Sauna activities	seats in dressing
Swimming activities	
Lockers activities	lockers
Health care activities	consulting workplaces

Building management activities

Garbage disposal activities	total square meters
garbage collecting activity	total square meters
waste sorting activity	total square meters
Cleaning activities	total square meters
cleaning closet activity	total square meters
cleaning store activity	total square meters
cleaning personnel dressing activity	seats in dressing room
Maintenance activities	total square meters
maintenance storage activity	total square meters
maintenance workshop activity	total square meters
hvac- control activity	total square meters
Bomb shelter activities	total square meters

Workplace Planning is a continually updated resource allocation in relation to the working environment, its users and the organization's strategy. The systemization of a workplace planning concept consists of three parts:

- the Theory of Workplace Planning
- the Steering Model of Workplace Planning
- The Workplace Planning Procedure

The Workplace Planning Theory links workplace planning to production. A spatial investment in an operation competes for the same recourses as the other investments in the operations. Workplace planning is a process where valuable requirements for workplace production are determined through observing and evaluating the values of stakeholders against the organization's strategy.

The Workplace Planning Steering Model and Web-application Workplace Planning Procedure fulfill the theory's principles in practice. The created steering model is based on dialogue between strategic and operational management. It encourages learning, group working, transparency and the elicitation of viewpoints. It supports strategic and operative management's collaboration and mutual commitment forming.

Cover: Synapsia Rehibilation Center.
- architect Hannu Jaakkola,
- photo Jussi Tiainen

HAAHTELA - KEHITYS OY
Tinasepäntie 45, FIN-00620 Helsinki
tel +358 9 777 1820, fax +358 9 777 18250
www.haahtela.fi
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