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IMPLICATIONS OF LEAN THINKING ON THE PROCUREMENT PROCESS OF PUBLIC BUILDINGS

Case study at the construction department of Karlsruhe University, Germany

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SUMMARY

Public administration is one of the major contracting bodies for the German construction industry. Few studies refer to procurement processes for public buildings considering this process as one enclosing cycle, starting from demand formulation by the end-user until delivery. The present dissertation is based on literature research and a case study, analysing the procurement of public buildings at Karlsruhe University with the particular focus to provide process transparency by applying techniques of value stream mapping, regrouping of sub-processes, reduction of lead times as well as further heuristics of lean-principles to the respective processes.

At first the derivation of new production principles and their applicability to administrative process flows is explained. Value stream mapping of the procurement process of a public building is optimized within the case study by a number of proposals that reduce the number of consecutive sub-processes from 18 to 14 steps and restructuring the whole process. Furthermore the five prevailing lean-principles of value, value-stream, flow, pull and perfection are compared with the current situation and translated into the context of procurement processes in public administration.

The dissertation has to be seen as a first part of a comparative study, suggested to be conducted on the procurement process of public buildings in Brazil combined with further detailed analysis of lead times. This enables an exchange of best practices and the possibility to elaborate new concepts to improve processes in public administrations for the benefit of better value generation to the end-users.

Key words:

Procurement process, value stream mapping, public administration, lean principles

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1. INTRODUCTION

1.1. RESEARCH QUESTION

How to improve the procurement process on public buildings based on the lean principles?

1.2. OBJECTIVE

The overall objective is to propose a leaner model of the procurement process for public buildings with the focus on cycle time and transparency, based on a critical analysis of a case study in Germany. This case study considers the value stream process of large scale construction projects at Karlsruhe University.

1.3. HYPOTHESIS

The associated research hypothesis states that today lean principles are not applied in governmental organizations. Beneficial synergies exist by cogging together the different lean principles of production and to apply them to other business processes such as procurement (Wiegand & Franck, 2005). Cycle times can be shortened and costs reduced by banishing waste and providing transparency and value of flows on these processes.

1.4. JUSTIFICATION

Construction is often pointed as a wasteful industry and such understanding has motivated the development of the present research. Its theoretical framework adopts the concepts and principles of the “lean-production”, a production philosophy initiated within the manufacturing industry (Wiegand, 2005). The success of lean principles in manufacturing has motivated researchers and practitioners to transfer such knowledge to construction.

Womack and Jones (2006) state that the promise of lean principles is “a way to specify value, line up value-creating actions in the best sequence, conduct those activities without interruption whenever someone requests them, and perform them more and more effectively”. Otherwise, according to Gehbauer (2006) today in Germany there is a lack of conceptual and reality-proofed lean approaches in both, private construction-projects and government administrated projects.

In this research the focus is posed on the application of lean principles on the procurement process of public buildings, using a literature review and a case study as the main research strategy. The construction process of public buildings is generally under scrutiny by society, particularly when the issue is waste. That is the also case of Karlsruhe University, Germany, where the researcher carried out his field study. Furthermore, freed resources due to lean-administration could be used for core competencies of universities which could better focus on satisfying their customers, which are the tax-paying and voting people, thus, directly beneficial by means of monetary and social payback to the all society.

Karlsruhe University employs over 2200 people and was selected in 2006 within an evaluation process as one of the three elite universities of Germany, honored with extra funding for research. Hereby, the issues of quality measurements, efficiency, transparency and shorter lead times in procurement processes are also perceived as increasingly important within Karlsruhe. Project cycle times of several years for certain projects roll-outs evoke particular interest to investigate procurement processes.

1.5. SCOPE

The consideration of the university's entire administrative processes is out of the scope of this dissertation. Therefore a smaller entity is chosen, the construction department of the University of Karlsruhe (Universitätsbauamt). This department has the objective of controlling, evaluating and planning construction projects for the university on campus (DAW, 2002).

Santos (1999) argues that construction industry needs to incorporate flow and value principles into their practice. He depicts four points from the lean theory: reduction of cycle time, reduction of variability, increase of transparency and building of continuous improvement into the process. Two of these, the increase of transparency and reduction of cycle time are incorporated as main considerations of improvement within the case study of this dissertation. The choice of these two lean-principles is based on the assumption that higher overall-process transparency, derived from an overview of the current situation provides a sound starting point for future improvements. Secondly, the reduction of process cycle time as a measure is chosen because the prevailing procurement lead-times at Karlsruhe University are very long (several years for large construction projects), so that the demanding parties (students) often do not benefit any more from their request, as the project delivery time often exceeds the average studying time of 5 years. The other two measures suggested by Santos (1999) were not further considered. First because large construction projects are typically by nature given to be unique and very specific projects and since there is still the lack of a general process transparency, therefore it is not possible to start the reduction of process variability by considering only one case study. Secondly, "building of continues improvement into the process" is also out of scope of this study as the learning cycles between projects are too long to be captured here.

Procurement in the context of this dissertation is referred to processing an order, thus

starting from the demand for a new building until its delivery to the end-user. Therefore the process-cycle time refers to the whole procurement process of a construction project, defined as the process starting from the set-up of the first process step (demand formulation) continuing through order creation, planning, other intermediate steps and construction until the final delivery of the product to the customer.

1.6. OVERALL VIEW OF THE RESEARCH METHOD

This dissertation was carried out through a literature review and exploratory case study. The literature review covered the lean-production, lean-construction and lean-administration area. It started with a brief review of origins and basic principles of lean management that were initialized by the Japanese automotive industry (Ohno and Shingo, 1996) at the Toyota-company. Womack and Jones (2003) were selected as other main contributions in the literature review to describe the framework of the new production philosophy. Womack abstracted these principles from the Toyota-Production-System into a more general context, which today forms the frame of “lean-management”.

Lean-construction is derived from publications of the internationally acquainted authors such as Koskela (1992; 2000), Santos (1999), Formoso et al. (2002) and others. Lean administration is mainly derived from publications of Wiegand and Franck (2005) and the lean-management-institute in Germany (2005). Figure 1.1 illustrates the research strategy and scope of the study.

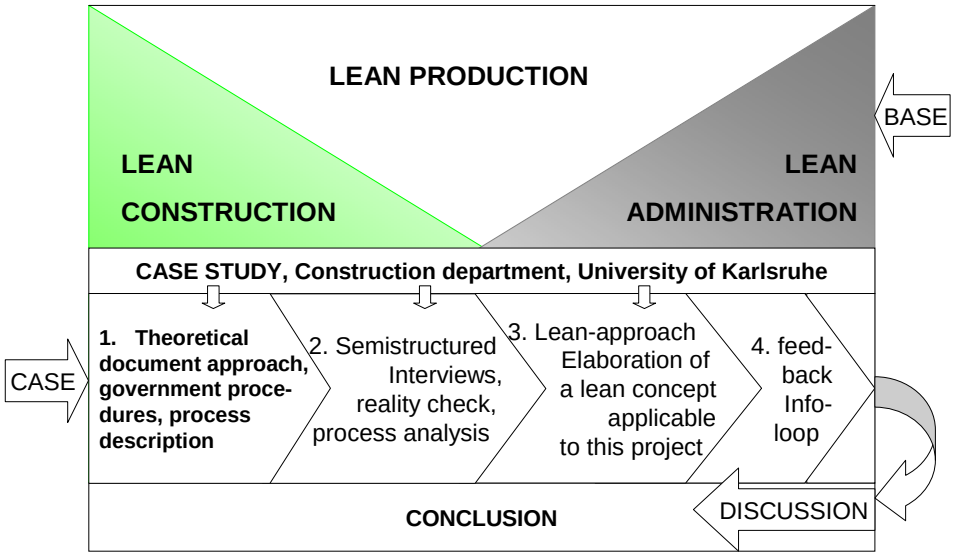


Figure 1.1 General View of the Research Strategy

The core of this dissertation is based on a case study developed on procurement of a public building project at the University of Karlsruhe, Germany. The focal points are hereby cycle time and process transparency, applying techniques of value stream analysis and lean-administration after Wiegand & Franck (2005), considering organizational forms, planning, information flows, waste and value. The dissertation is finalized with a discussion on the implications of the principles of lean thinking (after Womack and Jones, 2003) on this type of public procurement.

1.7. DISSERTATION OUTLINE

After having explained in chapter 1 the motivation, scope and objective of this dissertation, chapter 2 continues with a literature review. This contains as a starting point the lean-production historical background and the derivation of production theories from transformation over flow to the TFV-model, as well as principles and methods of lean management. Adjacently it explains in detail the implication of lean-principles as well as the translation and application of this theory into the administrative environment. These parts form the theoretical foundation for later use when evaluation the filed data gathered on the case study.

Chapter 3 contains the definition of the research method, validity and research limitations. Following the approach to proceed from general principles into details, chapter 4 continues with the case study, which analyses the procurement processes for large projects at the construction department of Karlsruhe University (Universitätsbauamt). This investigation is based on governmental documents describing the official procedures and semi-structured interviews with professionals within the case study for better understanding of particular organisation forms, lead times and reality based procurement processes. Adjacently is accomplished a value-stream analysis, regrouping of sub-processes and suggestions for improvements according to lean thinking principles. Chapter five concludes the dissertation and provides outlook by suggesting several directions for future research.

1.8. LIMITATIONS

The analysis of chapter 4 is considered only as a first step towards an implication of lean-principles applied to procurement of public buildings and does not include task-driven micro analysis on an activity base. Micro analysis is considered to be more difficult to conduct, as it requires access to real project data and task driven information. The approach of the case study is based on the official government process procedures and not on data of one specific project, as lead times for procurement have never been systematically measured. The perspective of this study is mainly derived from the university construction department and university administration. Furthermore, the cycle times for procurement are often higher than education cycles and currently the end-users are decoupled from financing institutions and even from the demand formulation (central administration head of the University). No investigations are conducted in the study about the influences of political priorities on speed and decision-making processes in procurement. All suggestions elaborated in the case study are theoretical approaches, proposing changes to dispose lean-principles for the improvement of procurement processes of public buildings. Not defined is the question of how to evoke and conduct such changes in public organisations, thus the

concepts of change management, motivation drivers and political criteria for decision making processes.

2. LEAN MANAGEMENT REFERED TO PROCUREMENT PROCESSES

2.1. CONTEXT

The present chapter provides a literature review about lean management and its implications on the procurement process, starting with the historical background, followed by a review of lean principles, flow and process definition. It also revises and presents some peculiarities of administrative processes and a road-map towards “lean” administration based on the literature. The content of chapter two is summarized in Figure 2.1.

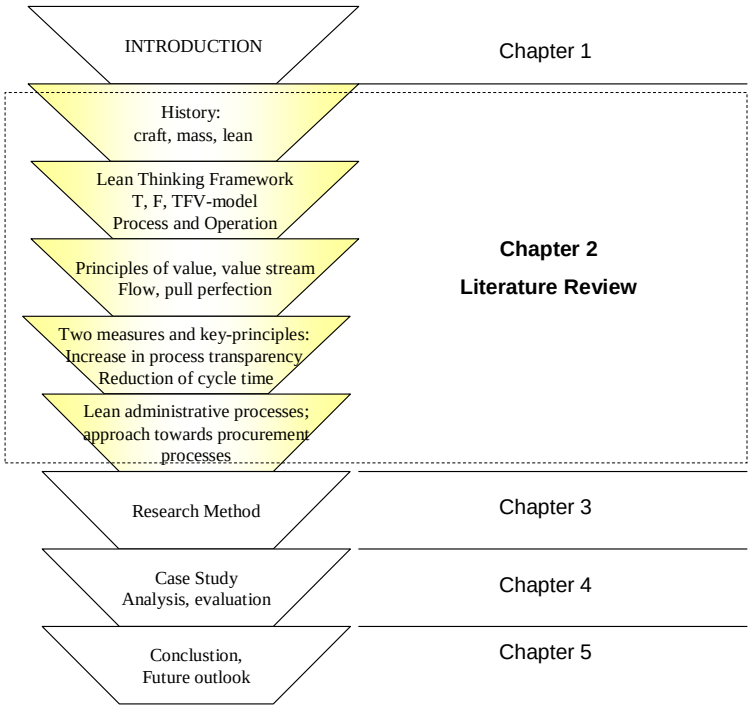


Figure 2.1 Overview of the content and structure of chapter 2

2.2. HISTORICAL BACKGROUND: FROM CRAFT TO MASS TO LEAN

The bid for higher productivity and quality on production and service systems exists since the beginning of mankind. From a technological point of view it started with the development of simple tools to support manual operations, later followed by development of machines, robots and information technology. From a managerial point of view it could be traced since the organization of hunting teams in primitive times until the agile organization of operators within manufacturing cells.

Key figures in the industrial revolution regarding early management and production philosophy include F.W. Taylor, F.B. Gilbreth and H. Ford.

- F.W. Taylor became famous for his time studies. The typical image of him remains, that of a "man with a stopwatch timing the length of a whole job". So he contributed significantly to production management by establishing the basic principles for optimizing the flow of production activities with a focus on time.
- F.B. Gilbreth started his career as a bricklayer[1]. He then became successful in business and returned to studies of efficiency at workplaces, where he focused on motion studies (Cheetham et al., 1992). As a pioneer and first "motion-study consultant" his third book became famous, the "Bricklaying system", where he emphasized on analysing a person's movements and deriving methods of working that reduced them (Cheetham et al., 1992).

Their ideas, developed at the beginning of the 20th century regarding work organization, material distribution, record keeping and physical movement have still great influence on industrial management today (Cheetham, 1992). At their time, America was under a process of fast industrialization and urbanization. It was also a

[1] Further reading about the background of F.G. Gilbreth at "the work of F.B. Gilbreth and its relevance to present day construction management", D.W. Cheetham, M.J. Steel, J. Lewis, University of Liverpool, 1991

turbulent and changing era concerning social and economical aspects. These changes were based on a situation of fast growing new markets and a super-abundance of untapped natural resources.

Moving from a craft based industry to a modern industrial power required a new way of thinking, described by the pioneer of scientific management, F.W. Taylor: "knowing exactly what you want men to do and then seeing that they do it the best and cheapest way". The aim was to get any given piece of work done as quickly and cheaply as possible, and so to increase the paying rate for the workers and profit rate for the employers (Cheetham, 1992).

The ideas of how things are produced, how people buy, how they think and the way of living were changed mainly after World War One, as Henry Ford and Alfred Sloan (of General Motors), integrating the ideas of Taylor and Gilbreth, moved world manufacture from craft production into the age of mass production (Womack & Jones, 1991). Craftwork production in automotive was reduced to niche sectors whereas the transformation of the industry towards mass production became very successful. It basically meant standardisation of operations, production in large batches, automation, mechanisation and line assembly. This "push" situation[2] of mass production became very successful as long as global automotive competitors were rare and world market was still demanding more capacities. European companies lacked behind and soon the United States dominated the global economy (Womack & Jones, 1991).

After World War Two, a new production was developed by Eiji Toyoda and Taiichi Ohno at the Toyota Company in Japan. This second transformation of the car industry after mass production became a success; it contributed to the raise of Japan's current pro-eminence (Womack & Jones, 1991) and is nowadays widely applied to automotive industries. The lack of resources and the urgent need to increase productivity during the reconstruction of Japan is pointed as driver behind the birth of lean production. The lean production thinking focuses on the continuous search for waste reduction and

[2] Push situation is referred to production without firm orders, to produce to stock.

increase of value adding activities (Womack & Jones, 1991). Next section presents the main principles that represent the foundation of this new production philosophy.

2.3. LEAN THINKING FRAMEWORK

2.3.1. Overview of lean concepts, principles, implementation and tools

According to Formoso (2000), the basic difference between traditional production theory and lean production is based on the conceptual understanding of processes and the perspective of value. Figure 2.2 provides a logical structure to the underlying production management theory, following Koskela's (1992) and Santos (1999) original proposition. The layers of the pyramid follow the hierarchical progression from high abstract to low abstract and link this information with the concepts and principles related to lean management that are further explained in chapter 2.

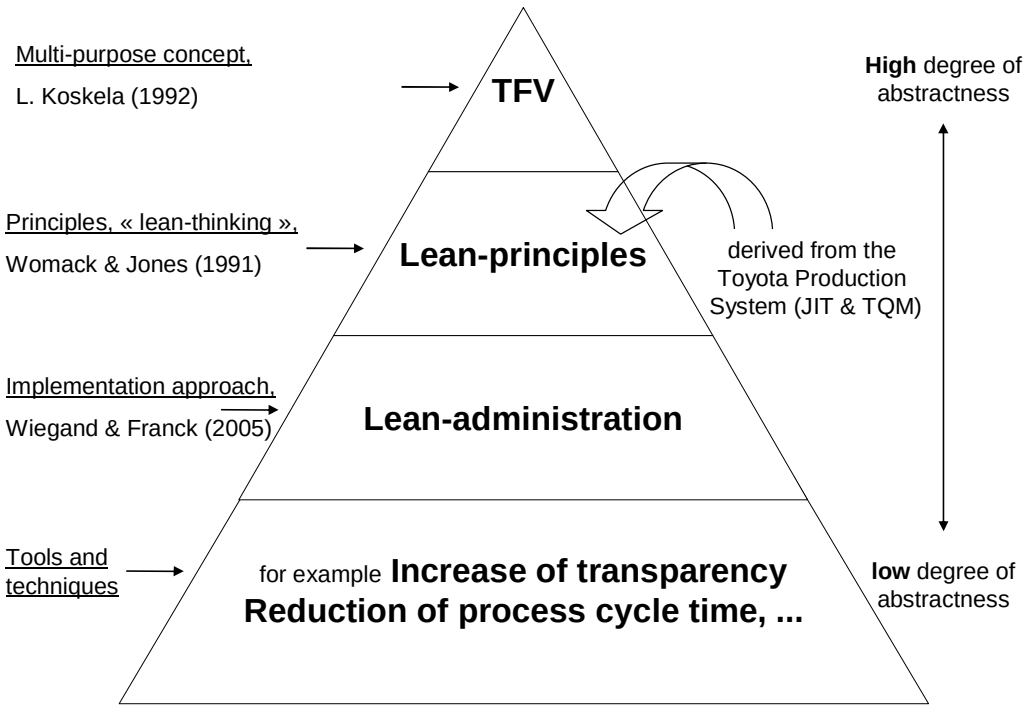


Figure 2.2 Abstract levels and overview of concepts, principles, implementation approach and techniques.

According to Koskela (1992) the uppermost level of this structure corresponds to the scientific notion of a theory here considering the multi-purpose TFV concepts (Transformation-Flow-Value). According to Santos (1999), such a multi-purpose concept should set the fundamental structure of our thinking and, hence, it can be used as a filter to understanding and analysing reality. The description of concepts has to be precise enough to avoid ambiguity and, paradoxically, flexible enough to allow adaptation to different purposes (Santos, 1999).

Santos apud Mc.Farlan (1979) states that adequate management concepts are needed before useful principles can be developed. Nevertheless, the lean-principles defined by Womack and Jones (1991) do not primarily originate in a theoretical concept, such as the TFV-concept of Koskela. Instead several principles were already acquainted, for instance the heuristics of cycle time reduction. Others, such as effects of batch size reduction and flows are derived from the Toyota Production System, established by Eiji Toyoda and Taiichi Ohno in 1960.

The third layer of the pyramid (in figure 2.2) presents practical implementation approaches of lean principles applied to administrative processes, following the proposition of Wiegand and Franck (2005).

The development and application of the theory in practice on a lower level of abstractness is supported by a number of tools and techniques, such as the reduction of process cycle time or increase of transparency. These tools are specifically designed to help the determination of specific answers to specific problems (Santos, 1999).

2.3.2. Production theory: the Transformation Model (T)

In the construction industry, the pre-dominant production model in practice and research has been the transformation model (T) which declares productivity as line-up of conversion activities, also called transformations. Koskela (2000) defines

transformation as converting a set of resources into a second set (input/output). Within this paradigm production processes can be characterized as a transformation process that can be decomposed hierarchically into sub processes of transformations, as illustrated in Figure 2.3. A typical management element of this model is the "Work-Breakdown-Structure (WBS) of sub-processes (Santos, 1999).

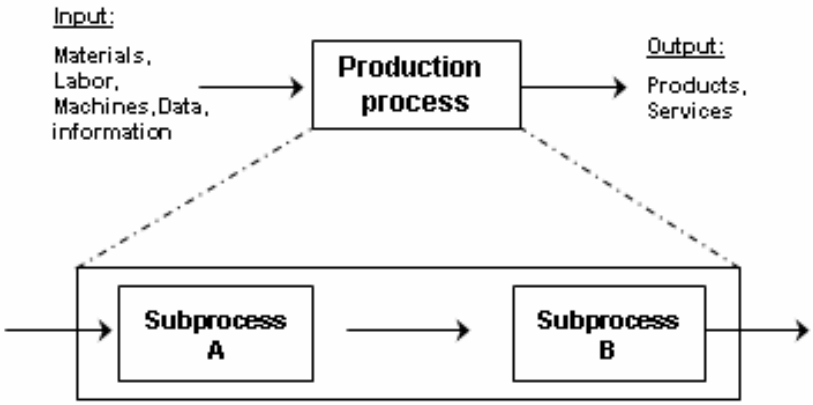


Figure 2.3 Model of Production on the Traditional Paradigm (Koskela, 2000)

Besides the aspect of decomposability of processes into sub-processes there are another two implicit characteristics in the transformation model (Koskela, 1992):

- The approach to reduce overall process cost is done by minimization of costs of each sub-process separately.
- The value of the output product of each sub-process is determined uniquely by the cost (value) of its input, assuming that the product value can only be increased by higher quality or better qualified labour.

Therefore the conventional production philosophy based on the transformation concept mainly focuses on costs of activities and increase of efficiency by implementing new technologies. It is further conceptualized in this paradigm of conversions that all activities are value-adding (Koskela, 1997). According to Gehbauer (2006), this is

still the predominant production model in traditional construction management. Lean thinking challenges this traditional paradigm by bringing attention to the flow activities and value chain that takes part on the whole perimeter of production processes and not only on the processing activities.

2.3.3. The need for differentiating Processes and Operations

In the context of complex production environments, the production theory of the transformation model contains certain deficiencies (Formoso, 2000):

- The existence of activities between sub-processes that do not add any value to the product contradicts the theory of the transformation model, which assumes that all activities of the sub-processes add value to the product. Formoso (2000) declares, that in particular in complex environments such as construction, the majority of costs are related to physical transportation. He even estimates that two third of the working time of construction labour is spent on operations that do not add any value to the product, such as transport, waiting material or re-work.
- Production control and improvements are rather focused on optimisation of individual sub-processes than the production system as a whole. Shigeo (1988) detected, that the efficiency of flows and other conversion activities can be deteriorated and improvement of global efficiency limited by excessive emphasis on optimization of single conversion activities[3], often achieved by technology

[3] Shingo Shigeo (1996) states: "Process refers to an analysis of production in large units and operations refer to an analysis of production in small units. There may be an unconscious assumption at work that improvements made in small-unit operations lead to improvements in collective processes. But production is a network formed by intersecting axes of processes (y-axis) and operations (x-axis). The two phenomena lie on different axes and their flows are by nature dissimilar."

innovations (Shingo, Shigeo, 1996).

- The T-model does not specifically consider client requirements, thus the requirements of intermediate and final customers within the production process (Koskela, 2000). Therefore even high efficiency of sub-processes can lead to inadequate products.

Nevertheless the transformation model is not considered as false. According to Ballard (2007) it is well applicable in relatively simple production systems, concentrated upon one transformation process. Thus in reality most production systems and construction projects are rather complex, market conditions become increasingly competitive and need higher customer focus. This tendency evokes inadequacy of the T-model and requires further differentiation between process and operations.

The differentiation between process and operations inherently implies that optimization of operations does by nature not necessarily lead to an optimization of the process. Process is defined by Shigeo (1996) as “the flow of products from one worker to another, that is, the stages through which raw materials gradually move to become finished products.” On the other hand an operation refers to the discrete stage at which a worker may work on different products, i.e. a human temporal and spatial flow that consistently centres around the worker.

Santos (2004) summarizes this differentiation by explaining that process is referred to the flow of material and information, whereas operation flow refers to the flow of people and machines that contribute to the throughput of the process. Therefore the assumption that processes (macro-process) show the big picture of a given production system and operations/tasks are the smallest parts of a process is wrong, because hereby process and operation is mixed on the same axis, which could mislead to the assumption that an analysis for an overall process improvement could be started on a given operation and not necessarily on the process.

2.3.4. The Flow-Model (F)

According to Koskela (1997), the core of the new production philosophy called lean production is in the observation, that there are two aspects in all production systems: Conversions and flows, defined as operations between conversions[4]. Hereby only conversion activities add value to the material or piece of information that is transformed into a product. This means that there exist four main different types of flows: transport, wait, processing and inspection/controlling. Transport is defined as moving material or information, inspection/controlling is the comparison with an established target standard, processing is the change in physical status or quality of materials or information and waiting is defined as the period of time where neither occurs a processing, nor transport or inspection/controlling (Santos, 1999). Besides processing[5], all other activities expend cost and consume time without adding value (Koskela, 2000). Therefore the aim is to focus on reducing or eliminating the non value adding flow activities (inspection/controlling, waiting, moving) and to increase efficiency of processing activities.

The concept of production as a flow (flow model (F)) is adopted in Santos (1999), illustrated in Figure 2.4.

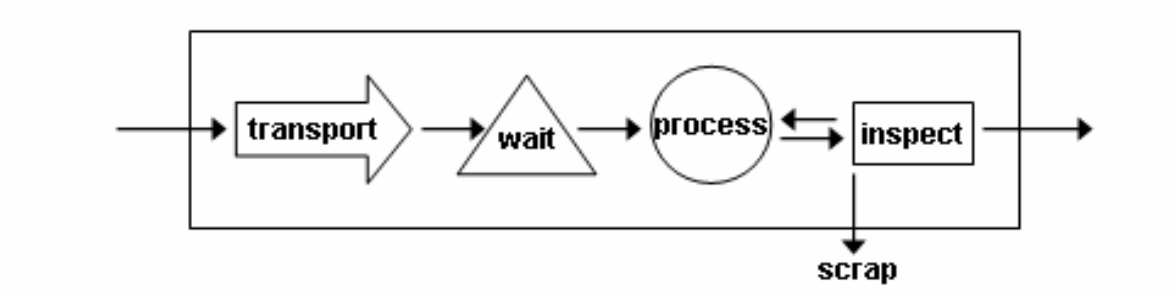


Figure 2.4 Production flow, four types of flow-activities (Santos, 1999)

[4] The term conversion is here used in the same way as the term transformation or processing.

[5] Even though, processing may not always add value (Santos, 2007)

The process flow model is applicable to material flows, information flows and labor-operations-flows[6]. In case of information flows such as planning, procurement or managing processes, the material component is replaced by information which typically contains activities of transport, waiting, processing and inspection/controlling (Formoso, 2000). In traditional production, flow processes have not been controlled or improved in an orderly fashion as all activities were treated as though they were value-adding conversions (Koskela, 1992). This evoked uncertainty and confusion in flow processes, expansion of non value-adding activities and reduction of output value. In the flow view, the basic objective is to eliminate waste from the main flow processes, obtainable by principles such as cycle time reduction, increase of transparency and reduction of variability.

2.3.5. The Transformation-Flow-Value Concept (TFV)

Koskela (1992) proposed the TFV- production theory, where the cited author combined the transformation (T) perspective of materials/data with the flow (F) principles of material or information and the value (V) generating view, considering the customer satisfaction and reduction of waste.

The value generation process as illustrated in figure 2.5 by Santos (1999) is part of this TFV-production concept. Production considered as a value-generating process positions the customer's perception and wishes as a trigger for subsequent transformation of the required information into product and service specifications. According to Womack and Jones (2003), value can only be defined by the customer and it is only meaningful when expressed in terms of a specific product or service, at a specific price and at a specific delivery time. This definition of value should affect all aspects of the way the entire production system is run, which often emphases on reducing non-value adding activities and increasing the efficiency of value adding

[6] Labour-operations-flow, defined by Santos (1999): Work-flow is the flow of humans or machines that carry on the work over each stage of the process flow, possibly dividable into set-up operations, principal operations, external operations and personal allowance.

activities (flow-model) so as to focus on potential competitive gains of costs and speed (Santos, 1999). Difficulties are found in incorporating the translation of value loss and reduction of value loss into an understandable production language.

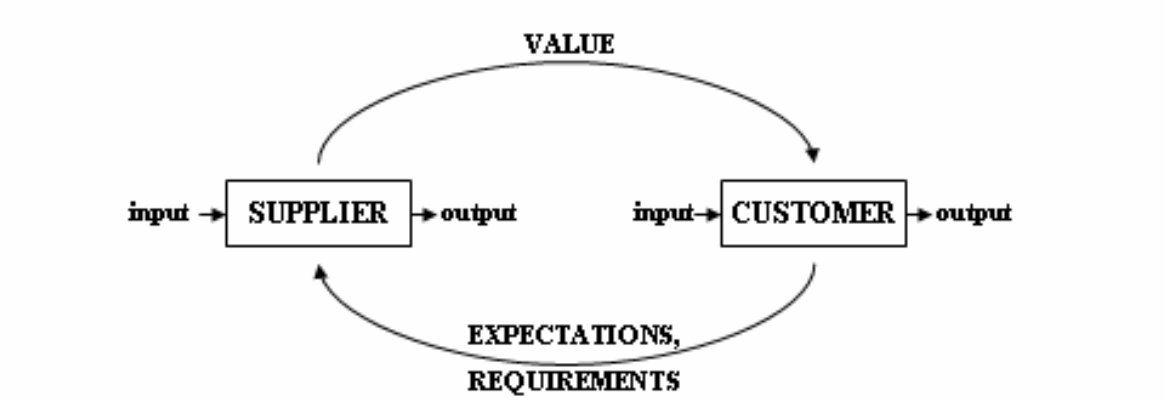


Figure 2.5 Value-model (V) of production process (Santos, 1999)

The differences of the three production theories, defined by its concepts, main principles, methods and practical contributions are outlined in Table 2.1.

Table 2.1 Different views of production management and engineering, in Koskela (1992)

	Conversion View	Flow View	Value Generation View

Conceptualization of Engineering	As a conversion of requirements into a product design	As a flow of information composed of conversion, inspection, moving and waiting	As a process where value for the customer is created through fulfillment of his requirements
Main Principles	Hierarchical decomposition; control and optimization of decomposed activities	Elimination of waste (non-conversion activities); time reduction	Elimination of value loss (achieved value in relation to the best possible value)
Methods and Practices	Work breakdown structure, critical path method, organizational chart	Rapid reduction of uncertainty, team approach, tool integration, partnering	Rigorous requirement analysis, systematized management of requirements
Practical contribution	Taking care of what has to be done	Taking care that what is unnecessary is done as little as possible	Taking care that customer requirements are met in the best possible manner

Taking flows as the unit of analysis in consideration, rather than the optimization of single conversions (activities) is a new conceptualization in the construction industry as well as in administrative processes outside construction. The combination of (T), (F) and (V) is called the Transformation-Flow-Value (TFV)-theory (Koskela, 1992). This consideration leads to profound changes of concepts and a new emphasis in production.

The TFV-production theory is derived from civil-engineering-production and process perspective which describes in principle the lean-production approach. In other terms

it is also called “World-Class-Manufacturing”[7]. It refers to the flow-model as a basis to distinguish between process and operation and combines it with the principle focus of value creation, which is directly linked to the customer satisfaction. Accordingly, processes can only create value, when the activities convert prime-material into products or services that are demanded by a customer. Fifield (2006) goes even further, declaring that the main objective of any production model is to create value for the customer by satisfying his requirements[8] and to generate profit for the company. Therefore the basic units of analysis of this new production philosophy are material and information flows, characterized by time, cost and value.

[7] Compare with “Capitulo 1, fundamentos da construcao enxuta, (Koskela 1992 and www.cpgec.ufrgs.br/formoso/pec009/Textos/LeanConstructionCap1.pdf, 2007): “Este novo paradigma gerencial tem recebido diversos nomes, tais como Lean Pdroduction (Producao enxuta), World Class Manufacturing, e Nova Filosofia de Producao (Koskela 1992)”.

[8] Nowadays there is also the ethical issue to be included in this reflection, thus satisfying the customer’s needs and producing according to certain social and environmental requirements.

2.4. LEAN PRINCIPLES ACCORDING TO WOMACK AND JONES: VALUE, VALUE-STREAM, FLOW, PULL, PERFECTION

As mentioned before, the lean philosophy proposed by Womack & Jones (2003) was first derived from the automotive industry at Toyota company which developed a particular production system called "Toyota-Production-System" (TPS) originated from the two streams of Total-Quality-Management (TQM) and Just-In-Time (JIT), Shigeo Shingo, Taiichi Ohno and, within the construction industry Lauri Koskela being its foremost thinkers.

According to Bonnevide (2006)[9], the translation of the term "lean" corresponds to the American translation of "agile-fit-flexible" rather than the British translation of "thin" as the application of lean principles signifies more than cutting and trimming. Wiegand & Franck (2005) declare that "lean" stands for "creating value without waste". According to Womack and Jones (2003) there are **five implementation principles** that represent the pillars of "**Lean Thinking"**[10]: **Value, Value Stream, Flow, Pull and Perfection**.

- **Value** is an attribute assigned to an object by its final customer (or, more generally, stakeholder), expressing the level of appreciation of him/her towards that object (Oehmen, 2005). For instance in a manufacturing setting, the customer is the ultimate judge of a product's value by taking all factors (such as performance, price, and availability) into account. The opposite of Value is defined as Waste, which is called "muda" in Japanese. According to Womack and Jones (2003) there are seven types of waste: overproduction, excessive inventories, unnecessary transportation, wait or idle time, inappropriate use of technology, unnecessary motion and queries and quality

[9] Claude Bonnevide; discussion between Hofacker and Bonnevide about lean-production related to the steel industry; Luxemburg, November 2006; senior consultant and involved in the preparation of the lean academy of the Arcelor-Mittal company.

[10] The approach of Womack and Jones (2003) is in practice the best known lean-approach and it reflects rather a pragmatic method to achieve lean systems, whereas Koskela presents eleven principles related to his TFV- theory.

defects (Shigeo Shingo, 1996; Womack & Jones, 2003; Wiegand & Franck, 2005).

- **Value stream** describes the value generation throughout the process or company. It aims at identifying the activities that directly relate to the whole process of value generation. This leads to the distinction of actions/operations/objects into three categories (Wiegand & Franck, 2005):

    - Value Adding (VA);
    - Necessary, but Non-Value Adding (NNVA);
    - Non Value Adding (NVA), (equal to waste or superfluous activities).

  The target is to optimize the Value Stream by eliminating NVA, minimizing NNVA activities, and to support and optimize the VA flow activities (Oehmen, 2005). The focus of lean-management is on the whole process (value stream) rather than optimizing and automating each single operation[11]separately.

- **Flow**, as presented earlier in this section, describes the easiness with which the Value Stream can cross organizational or other boundaries. The goal is to optimize the Flow of the Value Stream, thus minimize resource consuming obstacles to the Value creation process and aim for a continuous flow (Womack & Jones, 2005).

- **Pull** describes a basic control paradigm in which an upstream activity only starts after being triggered by a downstream activity. This can evoke minimization of the complexity of the control system and thus increase efficiency by lowering throughput and reaction times (Oehmen, 2005).

- **Perfection** describes the basic attitude that any technical or organizational system always can, and must be continuously improved (Oehmen, 2005).

[11] Process observation versus operation is elaborated in more detail previously in chapter 2.3.

Each of the concepts presented before contains different heuristic methods to enable their implementation in practice. Figure 2.6 provides an overview of methods that are related to them:

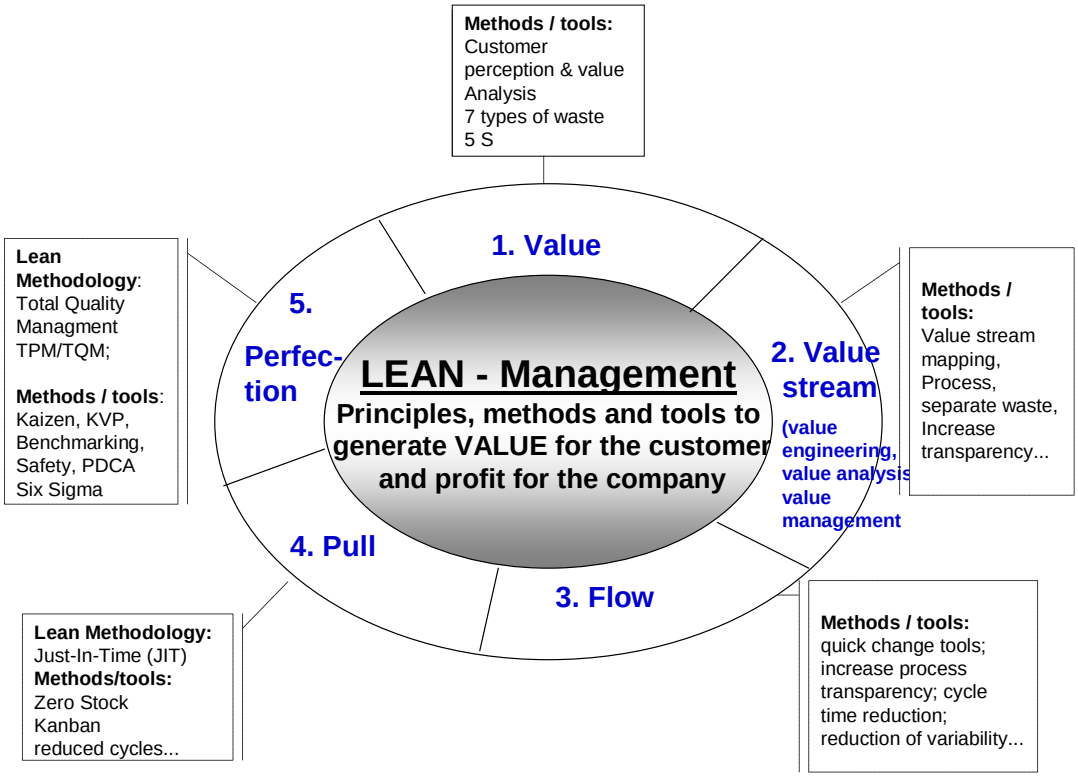


Figure 2.6 Overview of lean principles and respective tools and methods

These principles that are presented in figure 2.6 are held on a general basis, valid for the application of lean management to production. Most of them can be transferred to construction and administration as well, as long as one focuses on practical meaning of their abstract content. The transfer of the abstract content of such principles into practice usually demands further refinement and adaptation of tools and methods when working with industries such as construction. Two improvement measures, “increase of process transparency” and “reduction of cycle time” are further explained below.

2.5. TWO MEASURES AND KEY-PRINCIPLES

2.5.1. Increase in process transparency

The increase in process transparency in production means to improve the ability of a production activity to communicate with people (Santos, 1999). According to Galsworth (1997), an increase in process transparency can be adopted as one of the first steps in improvement programs, which forms a base upon which other improvement approaches are built. It signifies to make the main process flows more visible from start to finish through process mapping including physical and organisational means as well as display of information and measurements (Koskela, 2000; Formoso et al, 2002). Accordingly, successful implementation of process transparency yields in facilitated detection of abnormalities as well as higher awareness of existing types of waste. Therefore process transparency enables to conduct improvement measures more effectively as there is a strong link between incidents of non-value adding activities and information deficits at workplace.

Transparency is also considered as a motivation driver, expressed by Formoso et al (2002). In traditional work environment information and knowledge tends to be centralized. However, the absence of facts and communication of vague information to employees leads to distrust between each other. According to Galsworth (1997), scarce information brings along a sense of disempowerment, leading people to start worrying about making mistakes. Process transparency relates to a network of information, independent of hierarchical organisation structures, which can increase the motivation of employees.

Process transparency can be increased by various ways, depending on the type of process. Koskela (1992)[12] suggests following measures to increase process transparency based on case studies in construction industries:

- maintaining a clean and orderly workplace
- visual communication and removal of visual obstacles
- reduction of interdependencies between processes
- incorporation of information into the process
- rendering invisible attributes visible through measurements

The workplace itself is one of the first points to concentrate, captured by the 5S-method[13] from Japanese production philosophy, for keeping a clean and orderly workplace. Another key improvement towards transparency is linked to visual communication with four main types of visual devices (Galsworth, 1997): (1) visual indicators, (2) visual signals, (3) visual control and (4) visual guarantees, such as poka-yoke-devices[14].

Comparative case studies on process transparency of construction sites in Brazil and England (Formoso et al, 2002) found out that the reduction of interdependence between processes in construction leads to an increase in transparency as it allows the separation of processes in time and space. As a result, this separation reduces disruptions in process flows. Koskela et al (1992)[15] state, that the larger the degree of interdependence between different production units, the higher the degree of disruption and cluttering, due to the fact that large quantities of materials, equipment

[12] "Capítulo 1, fundamentos da construcao enxuta", , 1.3.7. Aumentar a transparência do processo., www.cpgec.ufrgs.br/formoso/pec009/Textos/LeanConstructionCap1.pdf

[13] Explanation of 5S: "Seiri" = proper arrangement; "Seiton" = orderliness; selecting locations; "Seiso" = cleanliness; "Seiketsu" =cleaned up, neatness; "Shitsuke" = discipline, good conduct; (Galsworth, 1997; Monden, 1993)

[14] Further reading: Formoso, Santos, Powell (2001), "An explorator study on the applicability of process transparency in construction sites, Journal of Constructin Research, 2001; page 40 following, "considerations on implementation of process transparency.

[15] "Capítulo 1, fundamentos da construcao enxuta", , 1.3.7. Aumentar a transparência do processo., www.cpgec.ufrgs.br/formoso/pec009/Textos/LeanConstructionCap1.pdf

and workers moving within the same area makes it difficult to understand and control processes. Therefore also the simplification of the process and reduction of interdependencies increases transparency and empowers for better control of waste and visualisation of non-value adding activities.

Value stream mapping is a tool that can be used to increase process transparency and highlight waste and value-loss. The often used method of value-stream mapping from Rother and Shook (1999) is derived from the Toyota Production System, with the purpose of mapping and visualizing both, the information flows between producer and customer, as well as the transforming actions on the product. An example of such a current state value stream map of a manufacturing process is illustrated in figure 2.7. The map below, adapted from Womack & Jones (2003) shows the flow of information from the customer to the various points in the production process, moving from right to left in the upper half. Orders are scheduled through a material requirement planning computer on a weekly basis through the system to devise the production schedule for the following week.

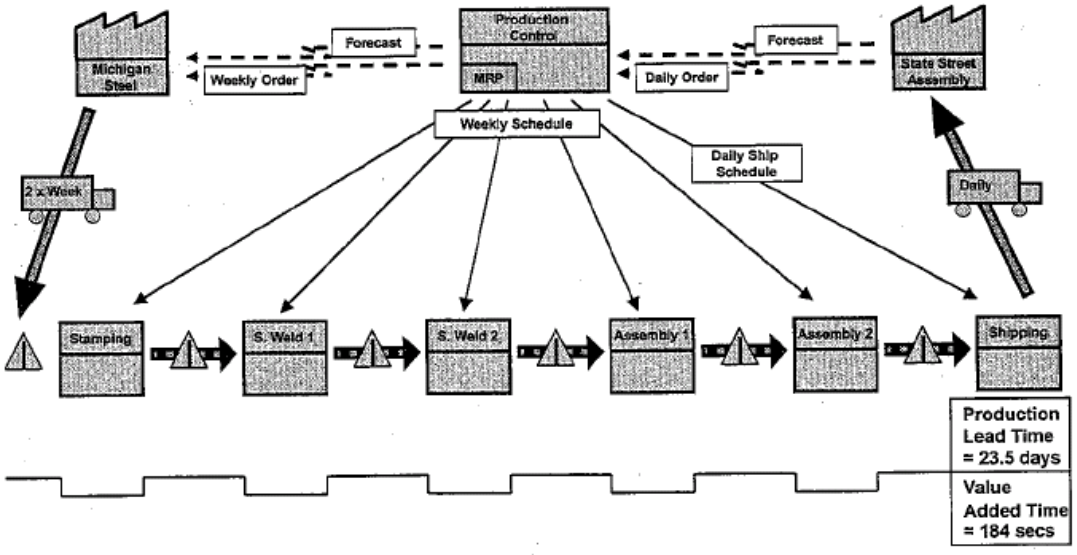


Figure 2.7 Example of a value-stream mapping of a manufacturing process (Rother & Shook 1999), (Womack & Jones, 2003)

2.5.2. Reduction of process cycle time

Process cycle time can be defined as sum of all times (transport, wait, processing and inspection) required for a particular "batch" of material or sub-products to traverse all stages of a considered process (Formoso, 2000, Santos, 1999). Process-cycle time is referred to the size of examined entity (batch, work in process) and its lead time. In general context, it is also possible to extract a part of the overall production process and to consider this as the entity for studies as a particular process cycle (Santos, 1999). Cycle time can be further divided into set-up time, describing all preparative activities and throughput time, including all the time that is spent in processing activities.

Part of the current meaning of the principle of "reduction of cycle time" originated in the philosophy of Just-In-Time and Total-Quality-Management (TQM)[16]. Reduction of cycle time has the endeavor to compress process cycle time, by reducing or eliminating all non-value-adding flow activities (wait, transport, inspection). Main advantages of reduced cycle times are defined by the lean-construction guidelines apud Koskela (1992):

- Faster delivery of the product/project to the client. This is often related with a reduction of financial costs and risk due to decreased capital bound as "working-capital" or "work-in-process".
- Easier process management due to reduced stock of semi-finished material.
- Faster possibility to learn from experiences, as reduction of process cycles is typically related to smaller batch sizes. Less overlapping with the execution of other production units eases further the possibility to quickly identify errors

[16] TQM has the objective to reduce the variability and therefore allows the reduction of process cycle time. The term "TQM" is in some literature referred to "Total-Quality-Management" whereas in other literature to "Total-Quality-Maintenance".

and respective re-tracking to its root-causes.

- Future demand can be easier and more precisely estimated as there is higher reactivity in the production-process system.
- The production system becomes less vulnerable concerning changes in the customer requirements and demand.

Koskela (1997) suggests the following ways to reduce the process cycle times, by eliminating non-value-adding activities:

- **Elimination of re-work** can be either achieved by classical quality measurements or an automation method using 100% inspection through autonomous checking of anomalies.

- **Waiting time elimination** can be obtained by time reduction of set-up times to reach one-piece lots in order to reduce lot-delays. So the batch size reduction leads to reduced lead times, assuming that output is constant, according to Little's formula (1961): lead time = work-in-process / output. This relation combined with improved load-balancing in manufacturing process supported by work standardization can also reduce queuing effects and waiting times. According to Wiegand and Franck (2005) these principle can be also transferred to information processing.

- **Elimination of moving and minimization of distances** requires a process based layout in order to reduce and minimize transport distances. For information processes this is less a matter of physical distance but rather the way of transportation and types of interfaces (internet, post-mail, manual delivery, phone-calls).

Furthermore, Koskela (1997) lists further seven implementation approaches: **Changing the order of the process; Synchronization and Smoothness of Flows; Reduction of Batch size; reduction of Work-in-Progress; reduction of variability; solution of Control Problems and Constraints to a Speedy Flow;**

Besides the approach of “increase in transparency” and “reduction of process cycle time” there are other lean-approaches for improvement of process-management such as continuous improvement, client value-consideration, higher output-flexibility, benchmarking, global process control and reduction of variability[17]. The following section describes the two before mentioned lean principles related to information processes in administration with the perspective of procurement processes of construction projects and a guideline towards its application.

2.6. IMPLEMENTATION: LEAN ADMINISTRATION RELATED TO INFORMATION PROCESS AND PROCUREMENT

2.6.1. Information process flows

Administrative processes and organizational functions occur in all organizations, no matter whether in the manufacturing sector or construction. Basic difference is that administrative processes in construction are especially related to varying and limited time horizons and locations, whereas in general manufacturing the processes are rather stationary. Even though that lean methods are widely spread in production of manufacturing industries, the associated organizational administration- and service processes itself are hardly performance-monitored. According to Wiegand and Franck (2005), it is the exception that administration processes are investigated for reasons of poor productivity, quality or performance.

Therefore Wiegand & Franck (2005) defined the term of “lean administration”, which is the application of lean management approaches and methods to the area of business processes, irrespective whether they take place in a company or in an administration

[17] Further reading: Koskela 2000, “An exploaration towards a production theory and its application to construction”. Norie, “Construcao enxuta, diretrizes e ferramentas para a reducao de perdas na construcao civil”, SEBRAE RS, 2001

institution. Administrative processes can be measured by considering business processes as chains of activities, comparable to assembly processes in production. Hereby are investigated information instead of tangible goods and each piece of information (figure or value) is equivalent to an individual item.

Wiegand and Franck (2005) state that an industrial approach for lean administration is to focus on customer value detection, on creating stable processes with defined interfaces, high productivity, few errors and a minimum of waste. The objective is to increase value, to improve the parameters of productivity, quality and performance in offices and hereby cutting the processing time.

Administrative services understood as "business on demand" with an inherent perspective of what is defined as value for the customer, this means (Wiegand & Franck,2005):

- To obtain high **availability** of services (by reducing the number of interfaces, elimination of bottlenecks and shortened process chains);
- high **quality** (by standardized forms, accurately defined input and output data, process description and defined quality criteria);
- **individuality** (by breaking down the whole process into partial individual processes, modules)
- low **costs** (by eliminating all sorts of waste and reducing all non-value adding but necessary activities).

Another point not mentioned above is the **reduction of value-loss**, which in practice is more difficult enclose, as defined as the conduction of measures to reduce the gap between the estimated potential value versus the currently achieved value.

In most companies and also in governmental organizations, administration has hardly any detailed knowledge of the structures of individual processes and costs. Instead, there is often acceptance and trust that things have to cost what they cost, even though

the quality of these services often does not meet customer expectations, because of late delivery, incompleteness or faultiness (Wiegand & Franck, 2005). This is also valid for construction where there is high pressure on production and material costs, whereas the time aspect of delivery and its required quality of construction projects is in average only in 60% of projects attained, according to research studies of Ballad et al (2000). The reliability of process lead times, scheduling and planning is low, due to the fact of complexity and high uncertainty or inadequate management methods. This matter is not purely related to the production and information process itself, but to organisational processes and information flows.

As mentioned in previous sections, avoiding waste is one of the main objectives of lean management. Superfluous or waste can be found in almost every company, public authority and administration department. Here this kind of waste in intangible goods is difficult to visualize, though often occurring in situations such as double handling of information or excessive waiting time. Once there is transparency of the process and time measurements, then it is possible to distinguish within the process the value-adding conversion activities from non-value adding flow activities (wait, transport and inspection). Figure 2.8 illustrates a part of a simplified information process flow. The x-axis illustrates the time-horizon of the process cycle with respective flow-activities[18] and mile-stones, such as finishing the pre-planning. This is a pre-phase of the process mapping, before attaining the real value-stream mapping.

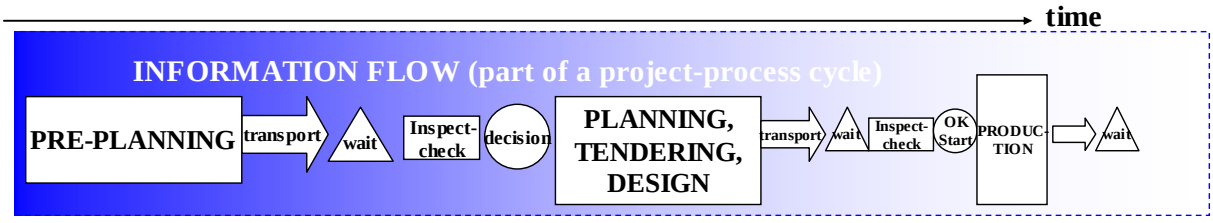


Figure 2.8 Flow of an information process, derived from (F)model, (Koskela, 2000); and "lean-administration", (Wiegand & Franck, 2005)

[18] It should be noted, that each of the mentioned core activities of Figure 2.6 and 2.7 can be further decomposed into sub-processes, as described by Koskela, 1992, Santos 1999, and in the previous section, 2.2;

Transparency of this process linked with measurement of lead-times enables to detect the potentials of applying lean-principles to the respective process and reducing the cycle time, which is described in Figure 2.9.

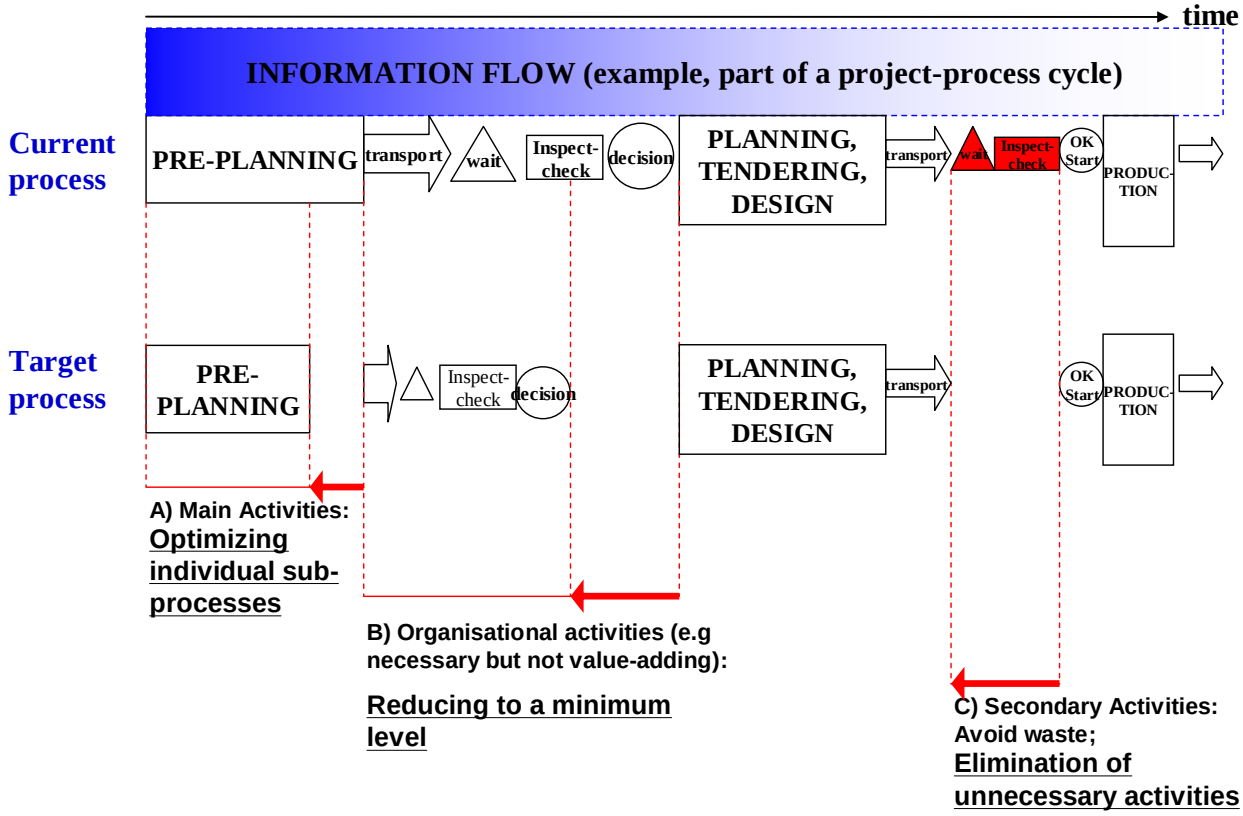


Figure 2.9 Potentials and possibilities to reduce process-cycle time in information flows, elaborated on the theoretical basis from Koskela (2000) and Wiegand & Franck (2005);

According to Wiegand & Franck (2005) there are inherent potentials of improvements in administrative processes, as indicated in Figure 2.9.

A) Once having identified the main activities that are necessary and value adding, it can be emphasized on optimizing these as sub-processes respectively. The difference hereby compared to the approach of Taylor with the transformation model is to focus first on aligning value-adding, only then focusing on flows and afterwards on optimizing sub-processes. In general information process context, the suggested

measures for the optimization of these core-activities can comprise the standardization of documents, data-forms and information input, automation of individual procedures and optimization of functional processes.

B) Organizational activities correspond to the non-value-adding[19] but necessary activities, some of them are related to transport, inspection or wait. Once clearly having identified these activities, it is the focus to eliminate or reduce them by means of either different ways of transport (e.g. electronic data transfer instead of post-mail) or simplified controlling procedures, by means of reducing these activities to a minimum.

C) Secondary activities correspond to the non-value adding and not necessary activities, thus they are not contributing to the value-stream. Examples in information processing are twice-performed activities or follow-up questions due to poor data quality. Depending on the level of detail, this analysis can be done on an activity based process analysis, as well as on a macro level. The last section of chapter 2 describes guideline towards an exploration of lean-principles to administrative processes.

2.6.2. Exploration towards lean-approach in procurement processes

As explained in the previous sections and approach to start a transformation towards "lean" should always first start with the perspective of what is defined as "value" for the customer and then to conduct a comprehensive analysis of the macro-processes, organizational entities as well as process lead-times and cost-structures.

The practical road-map for the transformation of current procurement processes towards lean administration processes adopted in this dissertation is based on the approach of Wiegand and Franck (2005) in a simplified representation. This approach

[19] However, organisational activities can be also value-adding in case that they're related to information that contributes to the alignment of value-adding processing.

was chosen because it illustrates in a clearer way the coactions of different stakeholders than the value-stream-mapping proposed by Rother and Shook (2004). According to Wiegand and Franck (2005) they suggest initiating the process-flow analysis with a multi-stage analysis, including value stream mapping of the macro processes of the current situation. This sequence and necessity towards value-creation of the inherent sub-processes (modules) of the macro-process has to be questioned before starting with an activity based micro-analysis or any optimization measures.

The principle to introduce lean administration to public organisations or any other administrative institutions is to take the organisation from its current status quo to an optimized target state and to implement lean principles into its daily activities (Wiegand & Franck, 2005). Four consecutive steps are suggested as an implementation approach, to make business processes transparent and transform an organisation towards a "lean" concept as a continuation of Womacks approach of "lean-thinking". Figure 2.10 explains the sequence and content of this approach, starting with a detailed Analysis (A), followed by Modularization and standardization (B), Integration (C) and Implementation (D).

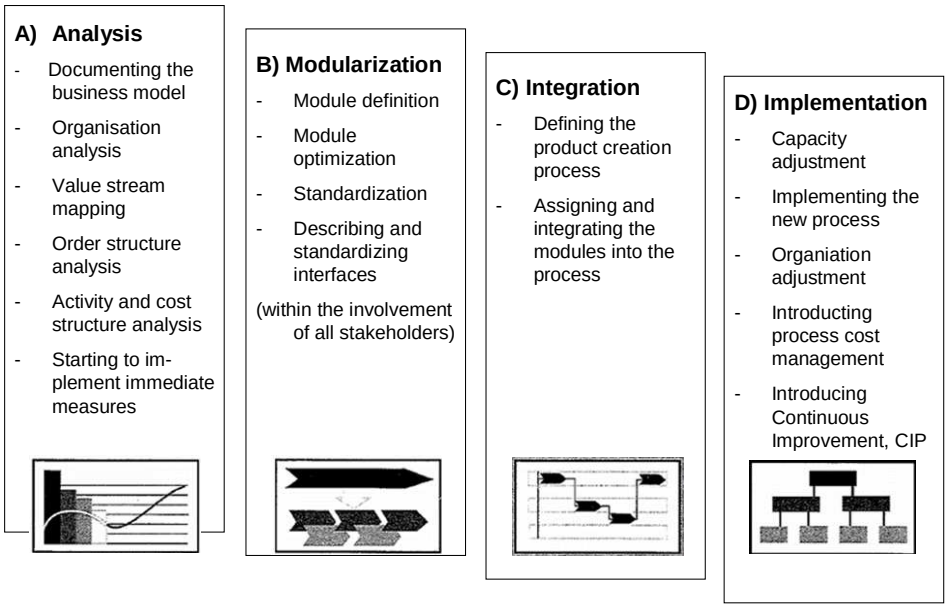


Figure 2.10 Four steps towards lean administration, (Wiegand & Franck, 2005)

A detailed **analysis**[20] (A) of the considered entity and respective processes is the starting point, by means of documenting the business model, detecting the sub-processes, value-stream mapping and order-and structure analysis. According to Wiegand and Franck (2005) this kind of analysis enables the fertilization of administration entities and information processes with lean-principles. Hereby the consideration of activity sequences and elimination of superfluous tasks are included.

Modularization and standardization (B) means to break down the previous determined sub-process and activity sequences into separate, self-contained individual processes or modules[21]. Each module describes the process in great detail of activities, regarding the content as well as type of operation (transport, waiting time, inspection, processing). The simultaneous objective is to standardize these modules and their interfaces to obtain flexibility.

The **Integration** (C), is the also called "product-creation-process", thus to clearly assign and to put all modules together to form individual products and services. **Implementation** (D) forms the final step, by means of integrating the new process into daily activities adjusting capacities (personal and organisation). It also means to implement continuous improvement processes (CIP) and take advantage of the flexibility obtained from applied lean-principles, for example the increased transparency and reduced cycle time to create more value for the customer, by widening individual services.

The above mentioned analysis (A) is the main emphases of the case study of procurement processes on public buildings. Conducting a detailed analysis before starting any improvement activity is aligned with the preamble of "first doing the right things before doing things right". This means that lean-approaches need to be based on a precise analysis of the current and measured processes, thus to apply improvement

[20] The detailed Analysis (phase A) is later in chapter two explained at greater length.

[21] A module can be either an operation or a group of operations; this entity is always the same irrespective of when and by whom it is performed (Wiegand & Franck, 2005).

measures to respective sub-processes, that are worthy, by means of value adding (VA) criteria, instead of optimizing superfluous non-value adding (NVA) activities.

The criteria for defining a sub-process being "worth" of improvement is related to its value itself, the frequency of occurrence, process details of functioning, process costs and time of each of the respective activities. Wiegand and Franck (2005) developed a multi-stage analysis system, to gather all essential data required for preparing a business-process lean-approach, explained in Figure 2.11.

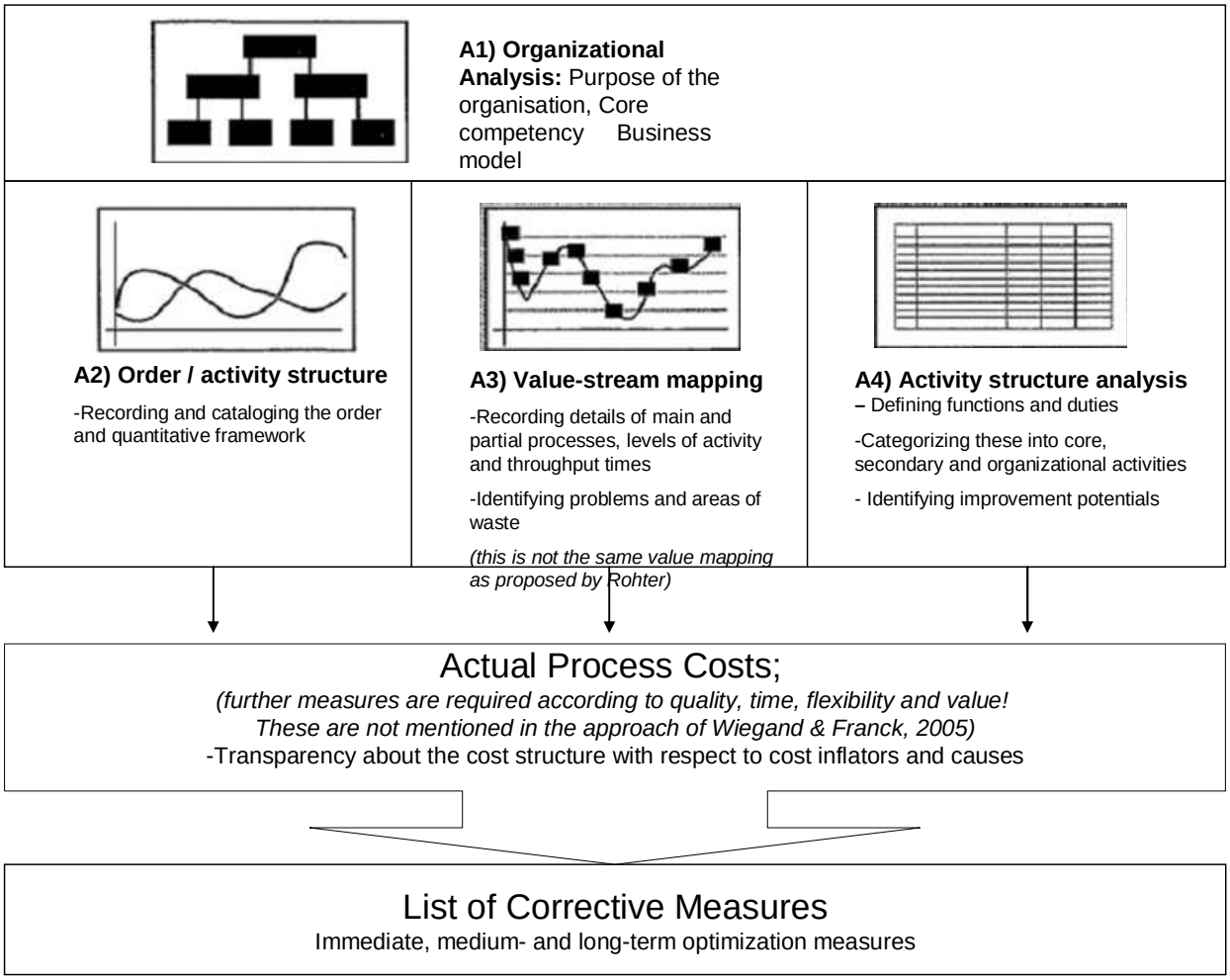


Figure 2.11 Multi-stage analysis system, (Wiegand and Franck, 2005)

This multi-stage analysis starts with an analysis of the organization as a whole. According to Wiegand and Franck (2005), the purpose of such a holistic organization analysis is to define the framework conditions, thus to identify the basic principles, value, core competencies and business objectives, as well as existing structures and volumes.

The second layer of analysis in Figure 2.11 contains the structure of orders and tasks, determining the volumes and frequencies behind each considered business process occurrence. In a next step all relevant activities (sub-processes) are recorded and mapped in a value-stream mapping, which illustrates the connections between the relevant activity processes and stakeholders, figure 2.12.

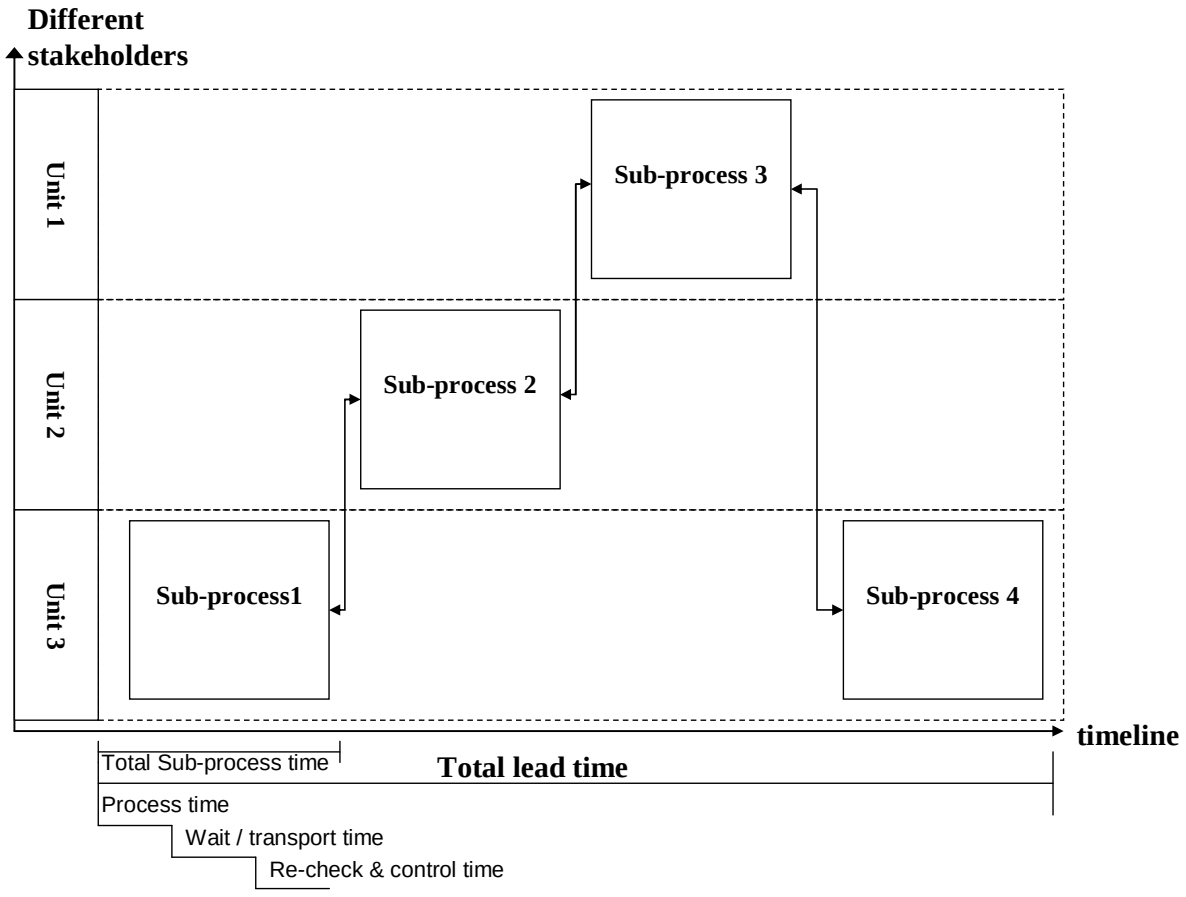


Figure 2.12 Simplified method of value stream mapping, related to the total lead time

This by means of value-stream mapping obtained visualization of a process cycle enables easier identification of process weaknesses.

Once the core activities of the business are defined and their processes are mapped, the last step of the analysis is to examine more details of the individual activity structures, linking the aspect of time with the mapped value-stream. Hereby the activities of employees and their respective task-processing times are determined, which enables the categorization into core, secondary and organizational activities.

Combining the four analyses provides transparency about improvement potentials of the process. Wiegand & Franck (2005) suggest, that based on these information, a list of optimization measures should be derived, determining immediate, medium-term and long-term actions. Adjacently it is to proceed to the next phase of improvement towards lean-administration, as defined before in Figure 2.9, modularization and standardization of the process (B), integration (C) and implementation (D).

2.7. DISCUSSION AND SUMMARY

Historically lean management is derived from production philosophies of Japanese manufacturing industry and is today worldwide applied in the car industry but poorly applied in project oriented industries and administrative processes. Today there are still discussions and controversial opinions between scientists, consultants and managers, of how the scientific content of lean management has to be evaluated and whether the lean-management approach is to be considered as a real new production theory and management concept, or as a practical implementation approach, derived from Just-In-Time and Total-Quality-Management.

The difference of process and operations as well as the understanding of the TFV-model elaborated by Koskela (1992) as a multi-purpose concept is relevant to optimize the whole process flows as one value stream instead of single activities. The five lean principles as defined by Womack & Jones (2003) consider value, value stream, flow, pull and perfection, with the focus on customer satisfaction and avoidance of all kinds of waste. This leads to an implementation approach towards lean administrative processes, as suggested by Wiegand and Franck (2005).

Lean principles are transferable to administrative entities and information flows, hereby considering information and data instead of material items. Focusing on the "value-mode", the application of lean administration is suggested to be rolled out in four steps: 1. analysis, 2. modularization, 3. integration, 4. implementation. A multi-stage analysis can herby form the main starting point to explore lean-principles to administrations and the emphasis of the case study in this dissertation, which considers the project procurement of buildings in the public sector. Nevertheless, the focus of Wiegand's and Franck's (2005) approach in Figure 2.12 is mainly focused on costs and does not include measures about quality, flexibility and value.

The relevance of process transparency as well as reduction of cycle time as measures of lean-management is highlighted in the approach of this dissertation. In the glossary

are also added the definitions of “project management”, “lean administration”, “process” and “operation”, to provide a clear differentiation between the relevant terms of this chapter.

The typical type of value stream mapping defined by Rother & Shook (1999) as illustrated in figure 2.7 was not followed within the case study of this dissertation due to two reasons:

a) Different from the Toyota-Production-System with the main stakeholders “producer” and “customer” there are seven different stakeholders detected in the case of procurement of public buildings at Karlsruhe university. This will be explained in the case study of chapter 4. Therefore the approach by Rother & Shook (1999) does not provide a clear synopsis for such a multitude of stakeholders.

b) In procurement of public buildings there is no Material-Requirement-Planning section that triggers and concentrates the scheduling for new production and planning as it is typically in manufacturing processes. Even more, as later discussed in the case study of chapter 4, there is currently a lack of any entity as a being the process owner of the whole procurement process.

Therefore the case study builds on the simplified process mapping approach in figure 2.12 instead of the typical value stream mapping approach based on Rother and Shook (1999). The next chapter presents the underlying research method.

3. RESEARCH METHOD

This chapter explains the research method that was adopted in this study and limitations of this method.

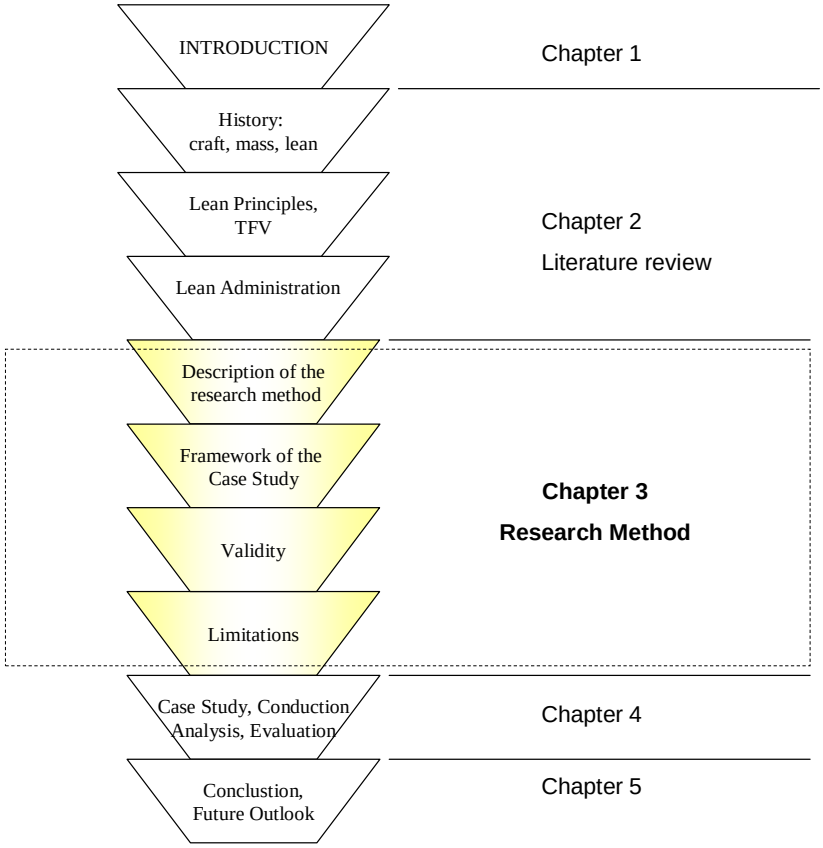


Figure 3.1 Overview of the context, content and structure of chapter 3

3.1. DESCRIPTION OF THE METHOD

In the classical way of science there are three main and traditional research strategies: experiments, surveys and case studies (Robson, 1993). An experiment measures the effects of measuring one variable on another variable for instance by selecting samples out of a population. A survey is held as a collection of information in standardized form from groups of people, usually carried out through questionnaires or structured

interviews.

A case study is according to Robson (1993) a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon or an entity within its real life context, using multiple sources of evidence[22]. Case studies differ from the other two strategies in that they are inherently multi-method (typically involving observation, interviewing and analysis of documents and records). Yin, (1989) states, that a study where the concern remains at a single, global level is referred to as holistic.

The first two strategies are considered not to be appropriate for the research question of this dissertation of *"How to improve the procurement process of public buildings based on the lean principles"?* First because the research question is less related to quantitative results and secondly because of the level of control within events of such procurement processes entails experiments and surveys to be less adequate than case-studies. Therefore the chosen one is an individual case study in form of a holistic case study, focusing on this particular institution.

The exploratory case study method is related to the purpose of the study, thus it is tried to find out what is happening within the macro processes and to seek new insights by posing qualitative questions. The chosen scientific method enables the inquirer to achieve the aim of examining and suggesting improvements on the current macro process of procurement by the analysis-method of value-stream-mapping based on literature research and the semi-structured interviews related to the case.

[22] In this dissertation referred to literature analysis and semi-structured interviews and governmental procedures within the case study.

3.2. FRAMEWORK OF THE CASE STUDY

The conceptual framework, design and proceeding of the case study is shown in the following diagram, Figure 3.2. The case study is based on three cycles, first a telephone meeting with the head of the department, clarifying the framework of the study. The second meeting was held as a semi-structured interview, focusing on an organizational analysis as well as project activities. The third interview considers one particular procurement process in more detail, in order to conduct a value stream mapping of the macro processes.

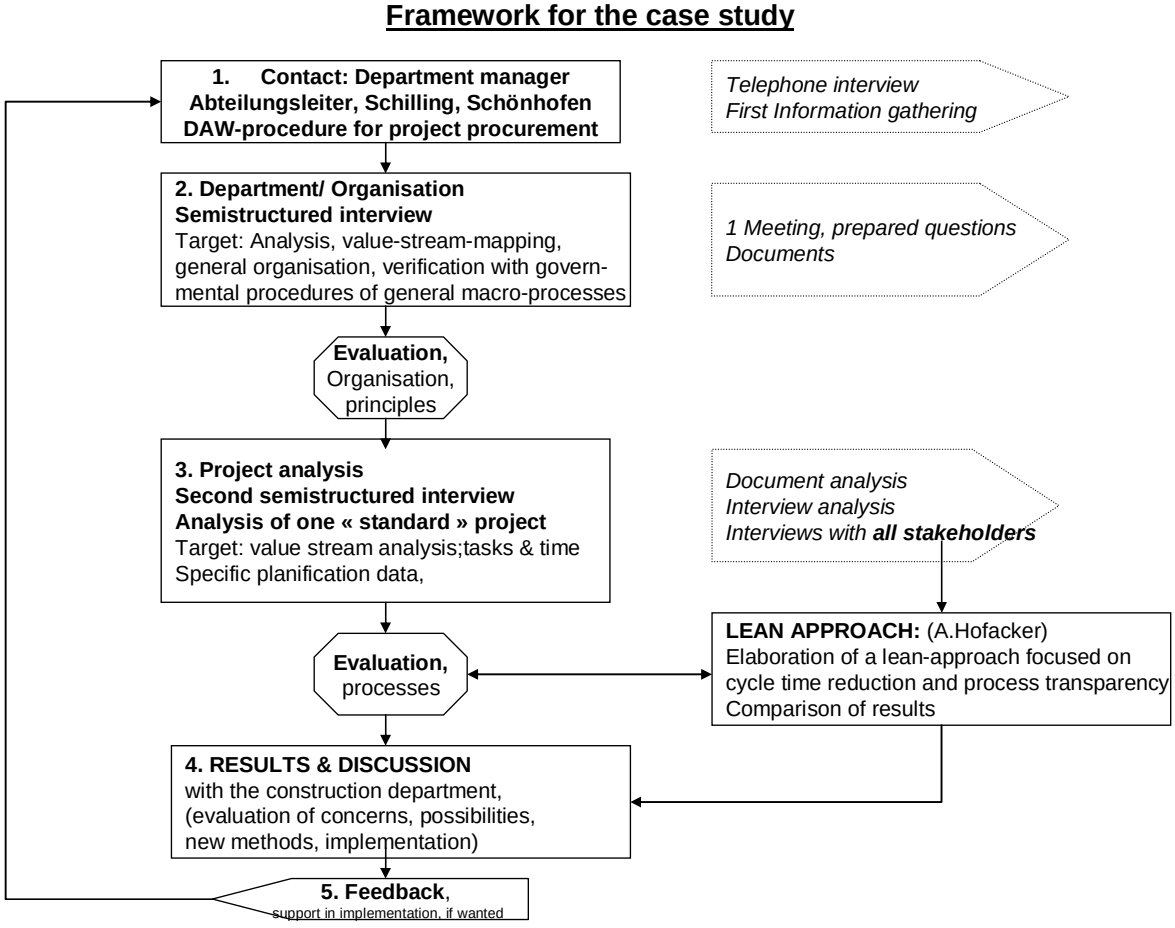


Figure 3.2 Flow diagram of the conceptual framework case-study approach

The **data collection strategy** within the interviews is referred to the four questions:

- **Who**: which persons are observed?

In this study, the head and one employee of the construction department at Karlsruhe University were interviewed three times, as well as end-users, represented by several informal investigations of the perceptions of students on public buildings and requirements for new constructions at Karlsruhe University.

- **Where**: in which settings are data collected?

Data is collected directly at the construction department via semi-structured interviews and pre-defined questions. Other stakeholders are randomly selected on campus of the university.

- **When**: at what time?

The timeframe of the overall study is conducted within 3 months, the interviews at the construction department are held twice, two hours each.

- **What**: Which processes are observed?

The macro processes of the construction planning and procurement are observed through document analysis of governmental guidelines and physical meetings.

The general process description is derived from governmental guidelines, which is then verified with the reality at the construction department of Karlsruhe University within the case study. Projects are defined as small, medium and large, according to the required resources, defined by the governmental guidelines in Baden-Württemberg, Germany (DAW, 2003). The analysis is based on a descriptive framework.

The selected data collection techniques are semi-structured interviews (predetermined questions with flexibility for modification of their order), systematic observation of the organisational form and offices and the use of documents provided by the construction department.[23]

Related to the lean-administration approach from Wiegand and Franck, it is the red-framed parts of figure 3.3 that are conducted in the case study of chapter four, applied to the procurement process of public buildings.

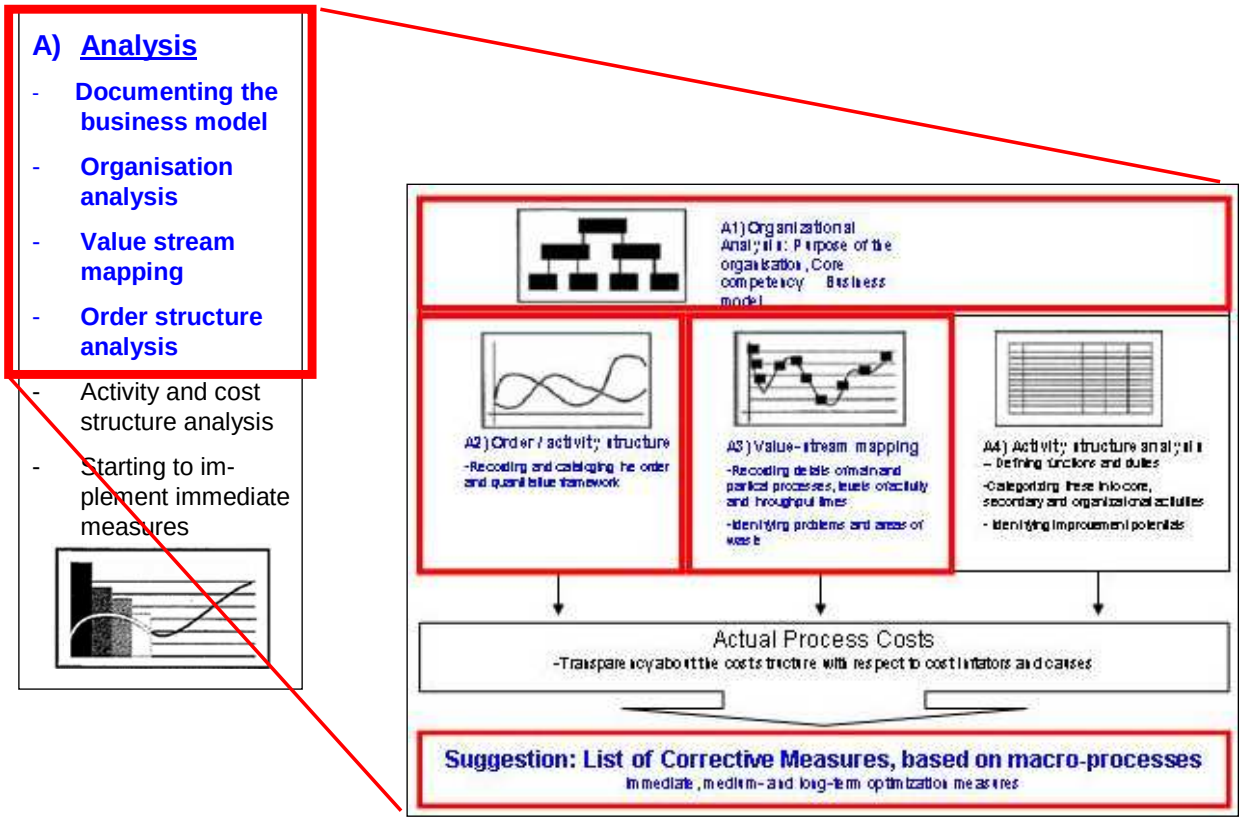


Figure 3.3 Selected parts of the multi-stage analysis within this dissertation, applied to procurement of public buildings

[23] An example of the questionnaire and a summary reports are added in the appendix.

This limitation of the case study is explained by the characteristics of public construction departments in Germany. For example, cycle times of procurement processes in public constructions have never been systematically measured in Karlsruhe. Further external factors caused by political decision making procedures and government budgets increase the complexity and complicate generalizations to systematically explain high lead times of procurement processes of public buildings. An activity structure analysis, thus the measurement of respective task-processing times of employees requires the participation, commitment and willingness of each employee towards this analysis, which besides of motivational concerns is time consuming[24]. However, a first part of an exploration towards lean-principles applied to procurement in public buildings can be done in that the procurement processes have many inherently repeated processes. Procedures therefore have already been produced and public construction organisations have to follow these guidelines. This is the opportunity to provide transparency to the general procurement process cycle from a macro process and TFV-perspective by value-stream mapping and retrieving first conclusions of how to reduce cycle time.

Applied to the procurement process of public buildings, Value stream mapping on macro level is obtained by the following steps (Wiegand & Franck, 2005):

a. Definition of the customer data, project type, (here A-projects), value and final customer (end-user)
b. Clarification of all functions and units of the different stakeholders that are involved in the procurement process
c. Recording of the basic process steps and triggering units
d. Adding the timeline and throughput times to the process

[24] For an entity such as the construction department at Karlsruhe University with approximately 30 employees it is estimated to take six month of full-time employment to conduct this activity structure analysis (Wiegand and Franck, 2005).

3.3. VALIDITY

According to Robson (1993), one of the strengths of a case study is its flexibility to emphasize on particular issues and modify questions according to the prevailing problems, as it is solely defined in terms of its concentration on the specific case in its context.

Internal validity is obtained by triangulation. According to Robson (1993) triangulation means to obtain information relevant to an issue from several informants in order to test one source of information against another source. Related to this study, it signifies to conduct interviews with several people of the construction department (supplier) and other stakeholders of the procurement process. The session summary sheet is sent to the respective interviewed person for verification and confirmation before being explored in the analysis. External validity is derived from literature results such as official publications for the proceeding of procurement in governmental organisations as well as adjacent discussions with specialists of lean management.

3.4. LIMITATIONS OF THE METHOD

According to Robson (1993) case studies are generally limited to the provision of theoretical generalizations about processes but they do not permit statistical generalization. Secondly, data of case studies are affected by the characteristics of the interviewer and respondents. In the process-study of the construction department the sample of interviewed people is relatively small. Therefore reliability can be only obtained by triangulation of data.

The generalization and validity of this particular dissertation is limited. Due to different environment conditions of public and private institutions it is not proved to generalize concepts and processes elaborated in this dissertation and to transmit these to private organizations.

No effects of different ages or gender of the respondents related to the outcome of

results are investigated within the dissertation. The transition to other public construction departments of other universities in Germany is also limited, due the exploratory nature of this study.

As the general procedures for project procurement (DAW, 2003) are officially published and compulsory to be proceeded by all public construction departments in the state of Baden-Württemberg in Germany there can be expected prevailing similarity of the macro processes from one department to another.

4. CASE STUDY

4.1. CONTEXT

The case study of this dissertation investigates current macro processes in procurement of construction projects at Karlsruhe University. The governmental leading entity behind is the construction department, called “Universitätsbauamt”. The chapter initiates with the description of the context and prevailing organisations and interdependencies of stakeholders as well as types and sizes of construction projects. Afterwards a presentation of a value stream mapping is made. It is based on semi-structured interviews and official governmental procedures for the procurement of large construction projects. The results of the macro analysis and interviews are evaluated and consecutively compared with a lean approach in order to discuss opportunities and limitations of applying lean management methods to this governmental institution. Content, context and structure of chapter four are illustrated in Figure 4.1.

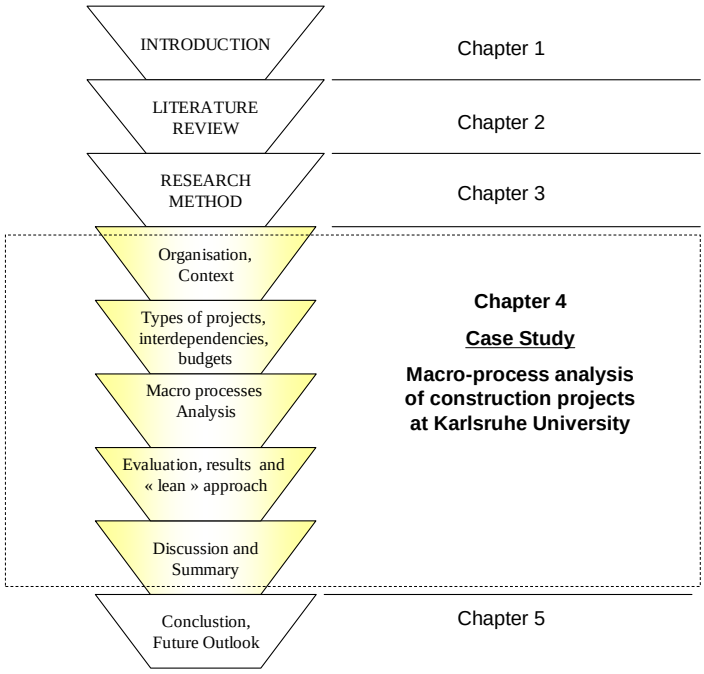


Figure 4.1 Overview of the content, context and structure of chapter 4

4.2. CONTEXT OF THE CONSTRUCTION DEPARTMENT

By law, the education system in Germany is based in the perimeter of responsibility of each State Government (Bundesland). In Karlsruhe and another eleven cities in the state of Baden-Württemberg, there are separate construction departments for the universities (Universitätsbauamt), as illustrated by the map, figure 4.2.

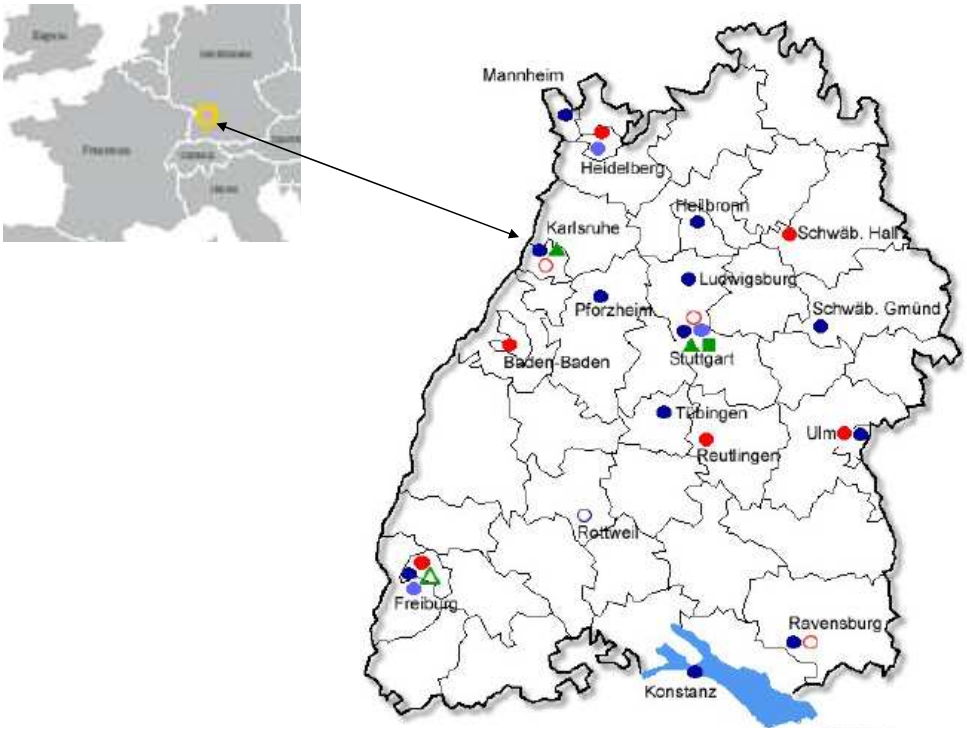


Figure 4.2 Map of Europe, Map of State Baden-Württemberg with the 11 construction departments, flash-Karlsruhe, (source: DAW, 2002)

The governmental real estate and construction departments are built in three levels of authority (according to the governmental procedures = DAW, 2002):

a) Financial ministry of each state as being the highest administration authority (Finanzministerium)
b) County control offices (Betriebsleitung, früher Oberfinanzdirektionen)
c) Local construction departments (Bauämter), split into real-estate management and construction management, some of them particularly

related to universities (Universitätsbauamt).

This distinction of three administrative and organisational levels is relevant for the degree of authorization to make decisions concerning construction projects and public investments. Universities are large administrative entities - for instance, in Karlsruhe in 2006 there were 18245 students enrolled and 2246 people employed, according to official publication of the head of the university. Therefore the infrastructure of these education centres is within the scope of responsibility of the state government, comprising the management of real estate as well as construction and maintenance.

4.3. INTERNAL ORGANISATION AND INTERDEPENDENCIES

The internal organisation of the construction department is split into two teams working on construction projects and another team which is dedicated to technical issues, such as heating installations and electricity. Each team consists of 8-10 people, led by a head department section (Abteilungsleiter). The interdependencies of the university, scientific staff, governmental financial institutions as well as executing construction companies are presented in figure 4.3.

The construction department understands its own function as a governmental institution with the objective to provide and preserve real estate in form of buildings and offices to Karlsruhe University (Schönhofen, 2007). The final end-users (students and scientific staff) are decoupled from the construction management and planning because the demand for new public buildings is received and centralized by the central administration department of the university, which is the direct contact partner of the construction department. A physical meeting between people of the construction department and central administration of the university is held on a quarterly basis to discuss technical and constructional issues.

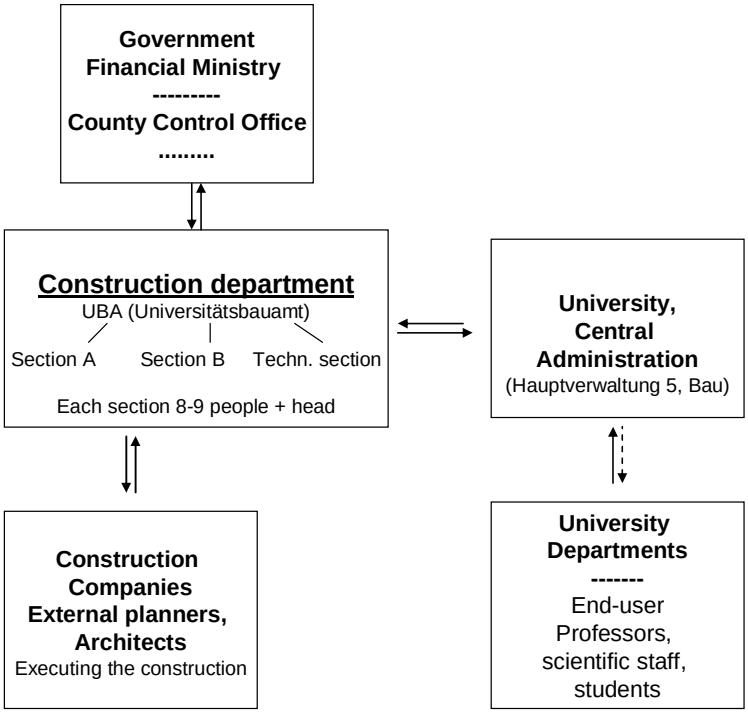


Figure 4.3 Interdependencies of the construction department and stakeholders, source: interview with Schönhofen (2007), (DAW 2002)

The decision making process and procurement is strictly defined by governmental procedures (DAW 2002). Projects are divided into small, medium and large projects according to the amount of resources required. Investment decisions for large projects must be authorized directly by the governmental ministry of finance, whereas medium and small projects[25] are authorized by the county control office and micro projects can be directly initiated by the construction department. The current process for procuring a construction project can be directly evoked by the construction department in case of new safety requirements (for example fire protection standards) or maintenance, which represents 40% of all construction projects in Karlsruhe (Schönhofen, 2007). The other 60% of procurement processes for public buildings are evoked by university departments, directing their requests to the central administration of the university. Here the demands are centralized and handed over to the construction department for

[25] Large projects > 1.25 million Euros, medium projects 0.375 until 1.25 million Euros, small < 0.375 Euros; compare with section 4.4, *"Budgets, Types of Projects, ABC-Analysis"*.

evaluation, elaboration and budget approval.

For later argumentation and comparison of the current situation with implications of lean thinking, it is necessary to provide some more information derived from the semi-structured interviews about the current situation of the construction department, tendencies and procurement processes.

- **Labour situation at the construction department, Karlsruhe**: the number of employees of the university construction department has been halved within the last fifteen years, although the investment volumes at Karlsruhe University maintained approximately at the same level (Schönhofen, 2007). For this reason the tendency is to pass more and more parts of the planning and design processes to external freelance architects, especially for bigger construction projects. However, each contract with an investment above 7500 Euros has to pass the official tendering process. In the past, most planning and design was done directly by the construction department;

- **Competition**: as being a governmental organisation, the construction department has no direct competition hence it is not benchmarked with external construction companies and has not the pre-requisite to become a profitable business unit. Nevertheless, benchmarking[26] is done between the eleven different university-construction departments in the state of Baden-Württemberg;

- **Clients and customer relationship**: the self-understanding of the construction department is to have the function of representing the building owner, the state government. In this case the central administrative university department which centralizes the requests from faculties and end-users is considered to be the client of the construction department. In the phase of formulating the utilisation request, there is direct exchange between both departments. Once this formulation request is closed and

[26] Benchmarking is conducted by comparing financial data, number of employees, costs, construction volumes; comparable data is retrieved from SAP-system and all departments are using this common ERP-information system.

accepted, the client has no right to ask for a major change[27]. In case that the delivered building-facility does not meet the client's expectations and required quality, this is typically communicated back to the construction department by claims;

- **Tendering and collaboration** with companies: Selected collaboration with certain companies based on preferences and good experiences is not possible, as all projects with an investment volume above 7500 Euros by law have to pass the public tendering process ("öffentliche Vergabe", Schönhofen, 2007). Hereby the first criteria for the selection is always price, second is to meet the required quality standards for the respective construction facility afterwards on time-criteria;

- **Working mode and self-assessment** of the construction department: the work distribution internally is done by dividing the university campus geographically into sections (Figure 4.4). Each employee is responsible for a certain area with the prevailing buildings and is in charge of upcoming projects. If necessary, further resources can be reallocated within one division of the department. In this way one employee typically works on several projects at the same time.

Figure 4.4 University campus, division of responsibility, construction department

[27] In practice if inferior changes are required, it is possible to do so, if this does not significantly affect the budget, (Schönhofen, 2007)

According to self-assessment of the construction head-department, the current way and performance of the procedure for procurement of public buildings is satisfying. Nevertheless improvement potential is seen in the currently high lead-times for the project approval and financial budget approval which could be reduced. Schönhofen (2007) states that "despite it is declared by the government that the target of public administration is to become slim, there are always added further administrative process steps!" The interest of the construction department is to conduct the procurement process of public buildings as fast as possible. However, the public tendering process remains a time consuming operation and allocation criteria of public resources are still based on price (1), quality (2) and time (3).

4.4. BUDGETS, TYPES OF PROJECTS, ABC-ANALYSIS

Over the last five years, the budgets for construction and maintenance at Karlsruhe University varied between 15 and 20 million Euros per year (Karlsruhe University, press release, 2005), illustrated in Figure 4.5.

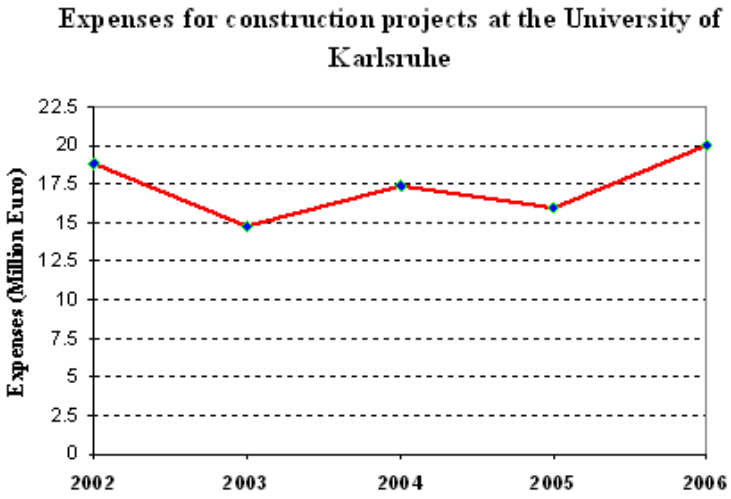


Figure 4.5 Diagram, Construction budgets from 2002-2006 at Karlsruhe University, source: University of Karlsruhe, (2005); and interviews Bauamt (2007);

According to the governmental procurement procedures and the required level of authorization, there are three types of projects, defined by its budget and maintenance size (DAW 2002):

- Large projects with an investment above 1.25 million Euros, related to the Financial Ministry
- Medium projects, 0.375 <= x <= 1.25 million Euros, related to the County Control Office
- Small projects, 75.000 <= x <= 375.000 Euro, linked to the County Control Office or Construction Department of the University
- Mini projects < 75.000 Euros, within the maintenance budget, linked to the Construction Department of the University

The following ABC-analysis reflects the frequency of project occurrence related to the cumulated investment volume over one year. Hereby projects are categorized into “A-projects” representing approximately 80% of the total budget size; “B-projects” up to 95% and the rest are defined as “C-projects”. Figure 4.6 is showing the current ABC-analysis of construction projects at Karlsruhe University in 2006, obtained from semi-structured interviews with the head department (Schönhofen, Wipper, 2007). The figure illustrates that a small sample of 15 projects in 2006 covered 80 % of the total construction investment, and the first 30 projects represent 95% of the total investment at Karlsruhe University, whereas approximately 700 mini-projects contributed to the total budget with an average investment of 1500 Euro each. The procurement process depends on the investment volume, therefore differs significantly between small, medium and large projects. Within this dissertation are only considered large construction projects, presented in figure 4.6 as A-projects with an investment higher than 1.25 Million Euros. 60% of these projects are initiated by a demand formulation from the end-users (scientific staff, students, faculties), the other 40% cover maintenance- and safety projects, initialized by the construction department.

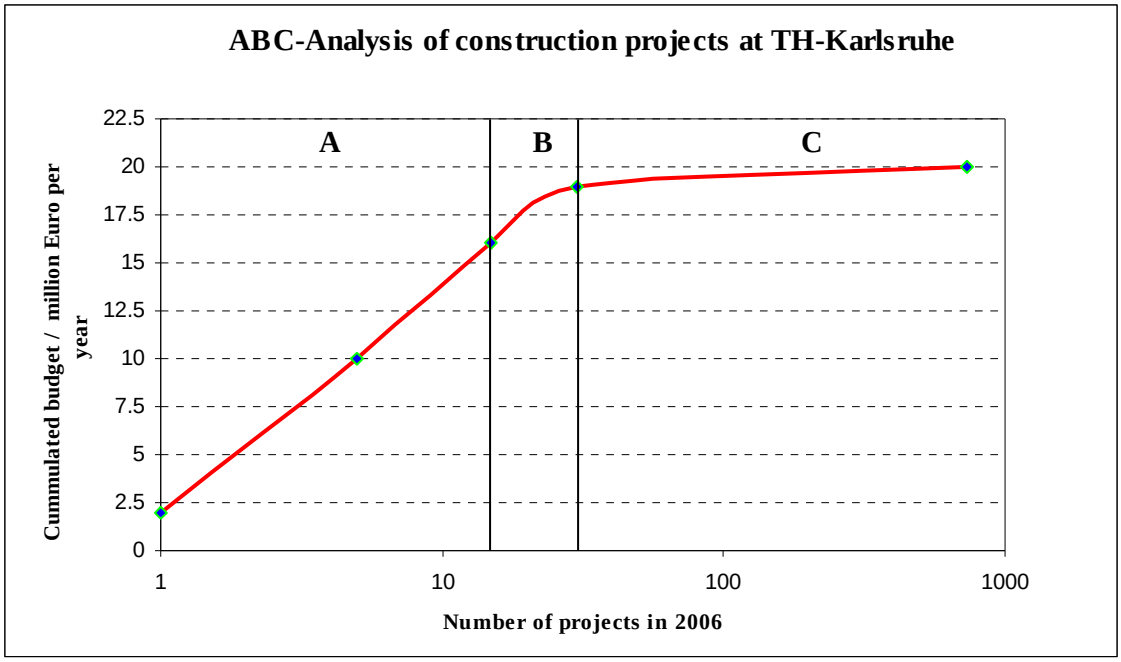


Figure 4.6 ABC-Analysis of construction projects, source: Schönhofen, (2007)

4.5. VALUE STREAM ANALYSIS, GENERAL PROCUREMENT PROCESS

According to Wiegand and Franck (2005), value-stream mapping is a lean management tool which was originally developed for value creation in the manufacturing industry. This tool is also suitable with some adjustments for the area of administration and services. The value stream is a visual documentation, indicating the value chain that a product or service follows. It provides an overview of the complexity of the respective process, its time sequence as well as interdependencies of different stakeholders. To this kind of process-documentation typically follows a detailed micro process analysis at an activity level, which can also focus on flows.

The outcome of the value-stream mapping of the procurement process of public buildings in Karlsruhe is shown in Figure 4.7. It is derived from semi-structured interviews with the construction department, as well as governmental procedures for public construction projects (DAW, 2002). This mapped process describing the current

situation was sent back to the construction department after the second interview to be proofed for correctness. There are seven different parties involved as stakeholders: the Financial Ministry (1), the County Control Office (2), the Construction Department (3), External Companies such as architects, planners and construction companies (4), Administrative Head of the University (5), University Faculties and Institutes (6) and the end-users which are students and scientific staff (7). The x-axis of the table refers to the time-line, which hereby only defines the sequence of consecutive sub-processes. This macro-procurement process is composed of eighteen consecutive sub-processes, each of them related to one or several stakeholders. The 18 sub-processes can be grouped into five main phases of the procurement process:

A.) Pre-Setup: Demand formulation, verification whether the demand is justified (1-7)

B.) Pre-planning: Budget estimation, preplanning and decision to invest (8-13)

C.) Real-planning and design: Tendering, planning, regulation of legal aspects (14)

D.) Execution of construction project, management and supervision (15)

E.) Delivery of the building, hand-in project, satisfaction of the demand (16-18)

Already at this stage can be stated, that the main value-adding activities are found in the real-planning design and execution of the construction project. However, the figures (4.7, 4.8, 4.9) and the text first presents the current process situation containing the main identified 18 process steps. Improvement recommendations and discussion is followed afterwards. The considered procurement process is related to projects that are requested by university departments, for instance the necessity for a new laboratory formulated by the chemistry institute.

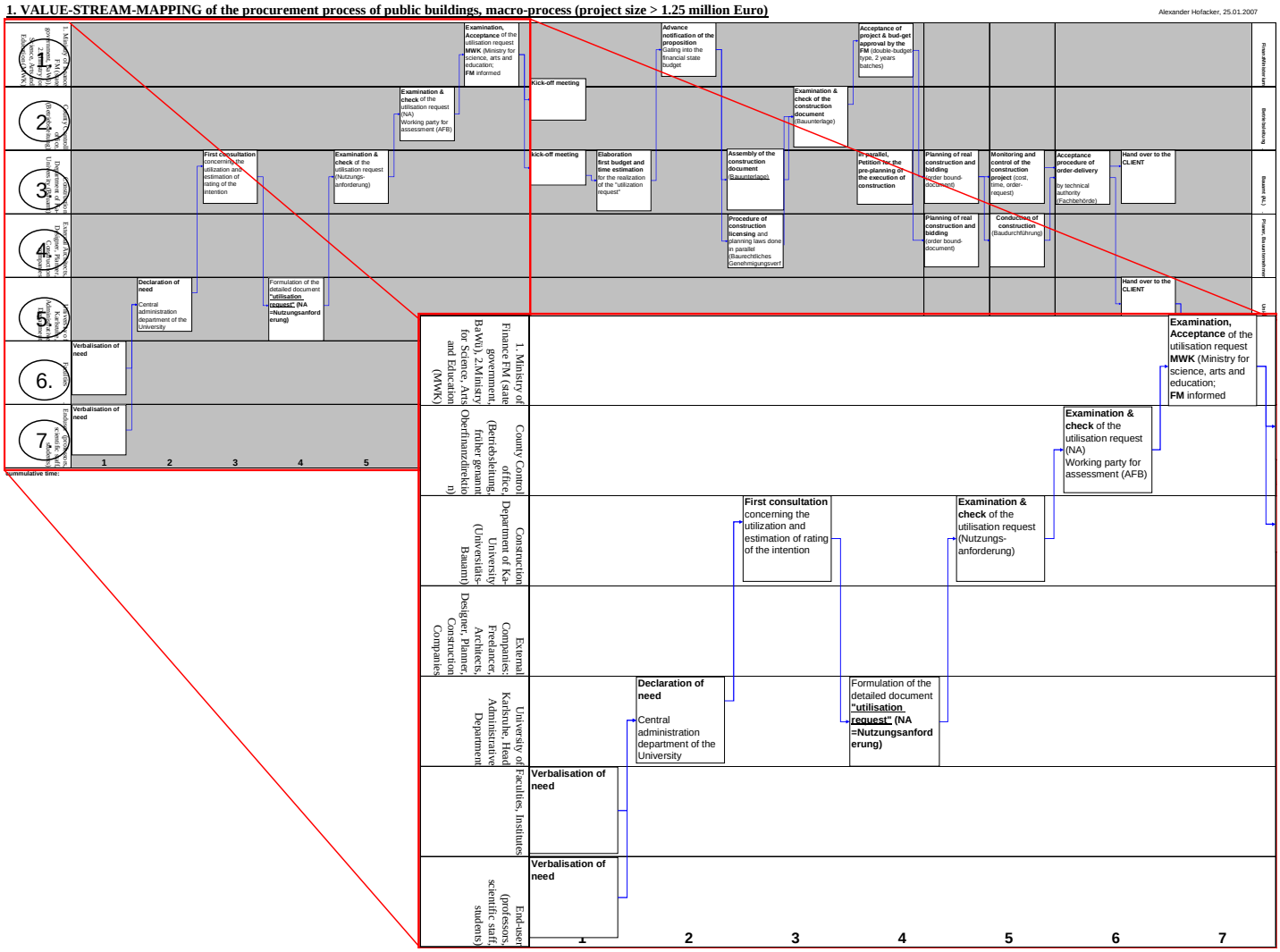


Figure 4.7 Overview of the value-stream mapping of the current procurement process of public buildings and extraction of step 1-7, pre-set-up phase

The main identified sub-processes of procurement explained in note form are the following steps, not all of them are value-adding in the current situation:

<u>Pre-setup and demand formulation (step1-7, figure 4.7):</u>

1. Verbalisation of need for a building facility expressed by a faculty, institute or end-users (students, scientific staff)
2. Declaration of need for a construction project centralized at the administration head department of Karlsruhe University
3. First consultation of the Construction Department concerning the utilization and

an estimated verification of the necessity and priorities; if ok then

4. Formulation of the "utilisation-request", which is a written document, describing in more detail the requirements of this procurement by the central administration department of the university to the construction department
5. Examination and check of this document (utilisation request) by the construction department; if ok then
6. Examination of the same document by a work group of the county council office; if ok then
7. Examination and acceptance of the utilisation document by the Financial Ministry and the Ministry for Science, Arts and Education

Pre-planning and budget estimation: step 8-13, figure 4.8

8. Kick-off meeting with the stakeholders: county council, construction department
9. Elaboration of the first budget and time estimation for the realization of this project, based on the requirements formulated in the "utilization request", done by the construction department
10. Advance notification of the proposition for this procurement project to the Financial Ministry, so as to gate this project into the financial state budget
11. Assembly of construction documents (called "Bauunterlage") by the construction department and in parallel request for the licensing of all legal aspects of this project, done by external planners or by the construction department
12. Examination and check of the construction documents (Bauunterlage) by the County Control Office
13. Acceptance of the project and budget approval by the Financial Ministry and in parallel the construction departments demands the petition for the pre-planning

of the execution of construction.

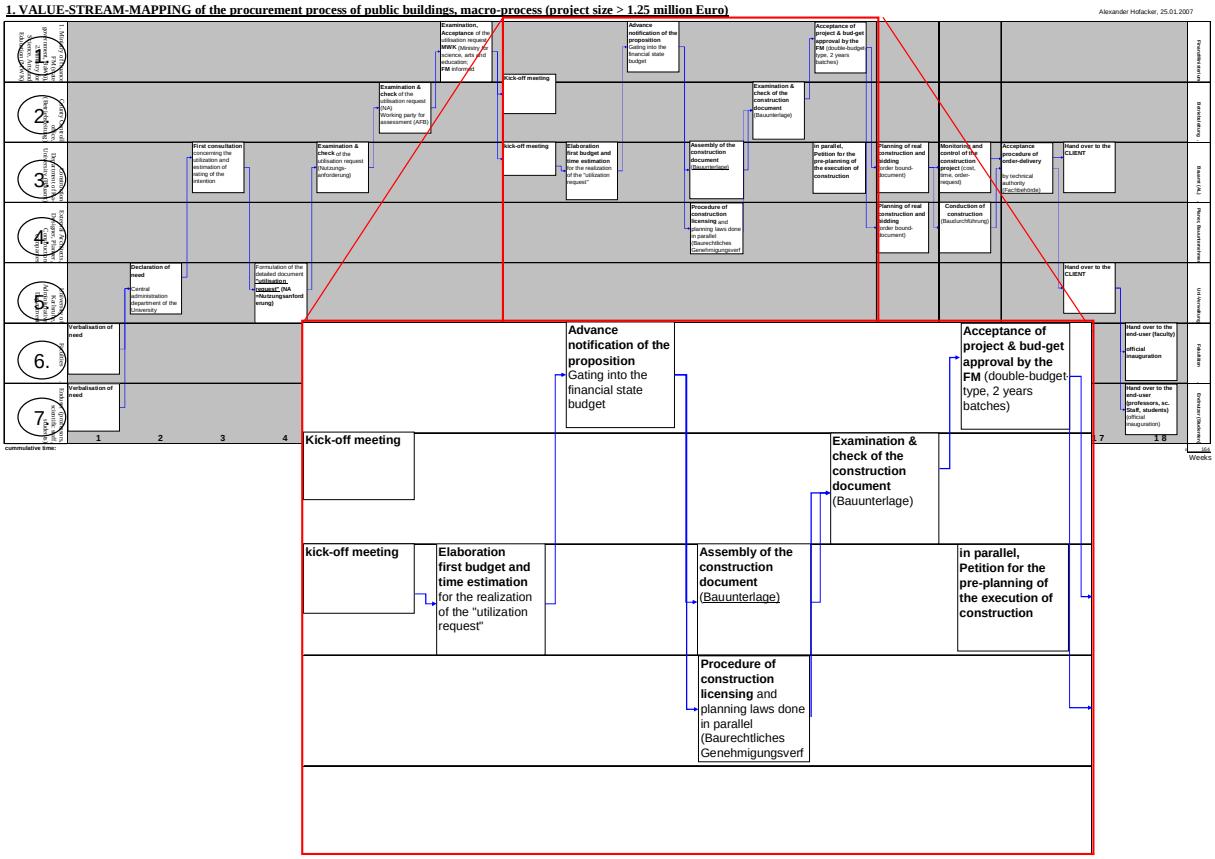


Figure 4.8 Current procurement process of public buildings, extraction of step 8-13

Real-planning, design and execution: step 14-15, figure 4.9

14. Real planning, public tendering, bidding and construction process conducted by the construction department with external companies and architects
15. Execution of construction by external companies, as well as monitoring by the construction department regarding cost, quality and time

Delivery, step 16-18, figure 4.9

16. Acceptance of order delivery by technical administration authority (technische Fachbehörde)

17. Delivery of the facility and handing-over the responsibility from the external companies to the construction department and administrative head of the university
18. Handing over the new facility to the end-users (students and scientific staff) and putting into service.

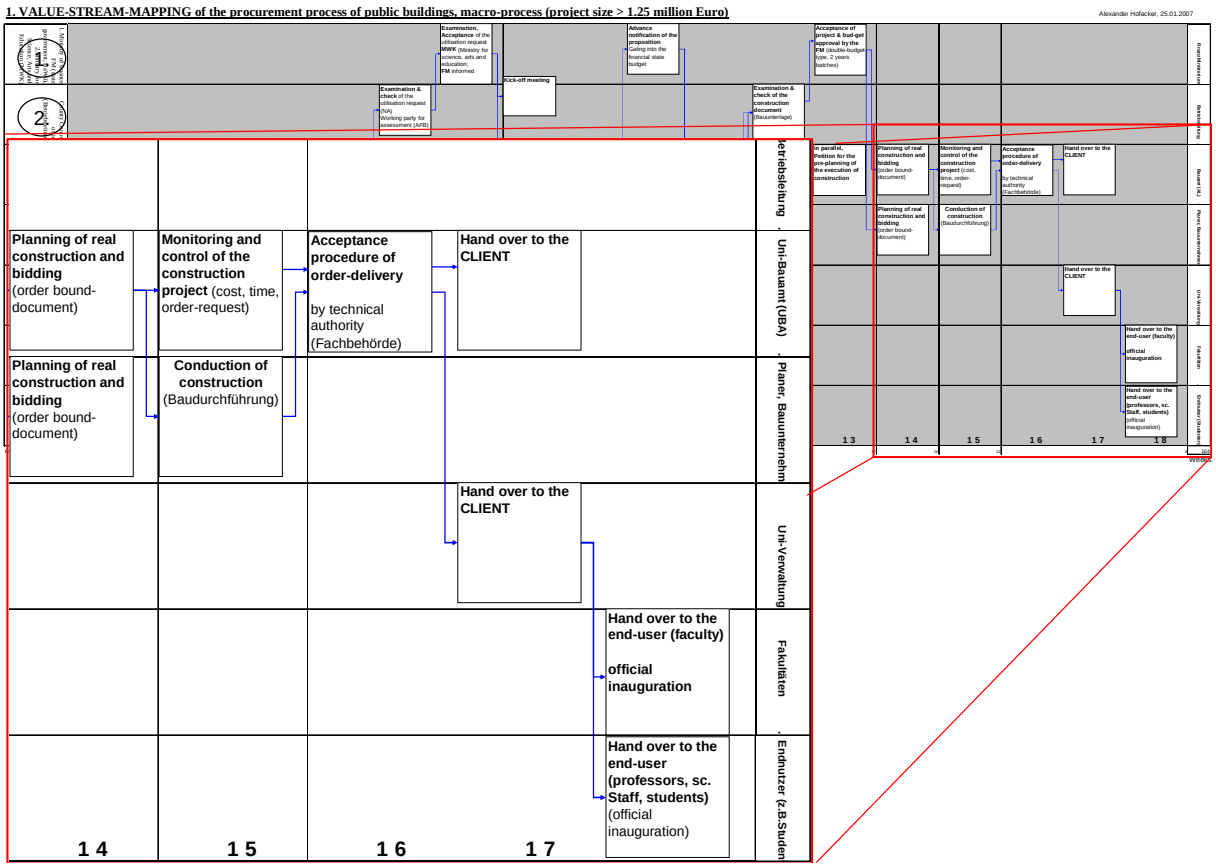


Figure 4.9 Current procurement process of public buildings, extraction of step 14-18

Each of these sub-processes contains elements of waiting, processing (for instance completing forms, designing layout), transport (sending the data and documents to another person or institution) as well as controlling that the data is complete and correct. However, first the focus is to on the “value-stream”, thus to align value first and then to look at the flow.

4.6. PROCESS CYCLE TIMES OF PROCUREMENT PROCESSES

There are no publications available about process cycle times of procurement of public buildings in Germany, not even internally in the organisation. Apparently this total process cycle has never been measured in public organisations, although the declared business objectives for these administrations is to work efficiently with regards to costs, quality and time (Schönhofen, 2007). The only time monitoring is accomplished for the sub-process of the construction phase. Here the construction department has the function to control the involved executing companies according to the criteria of combined quality, price and delivery time.

Therefore, estimated lead times as illustrated in Figure 4.10 do not permit any scientific generalization. Furthermore these lead times are project specific and highly depend on the political priority of the financial ministry. According to the head of the department (Schönhofen, 2007), the whole procurement process varies between 2 and 15 years for public investment projects higher then 2 million Euros, which is mainly contingent upon priorities of the decision making authorities. Within the semi-structured interviews was estimated a procurement process cycle time for a public building (project size 2 million Euro) under normal process conditions with a medium to high priority. This estimation of Schönhofen (2007) is illustrated in Figure 4.10. It must be only taken as rough indication to provide some basic understanding of process cycle time frames as there were never total time measurements done and the information here corresponds to their memory.

Scientific justification of standard process cycle times would require to investigate multiple projects of the same size and similar boundary conditions combined with real time tracking. However, from Figure 4.10 can be derived the aspect of having a minor fraction of time (here only one third) of the procurement process cycle time related to the construction phase.

As there are no measured lead times of procurement cycles available, the comparison

with lean-principles and improvement to reduce process-cycle lead time is purely accomplished by considering the sequence and content for the mentioned eighteen consecutive sub-processes, instead of numbers of real time.

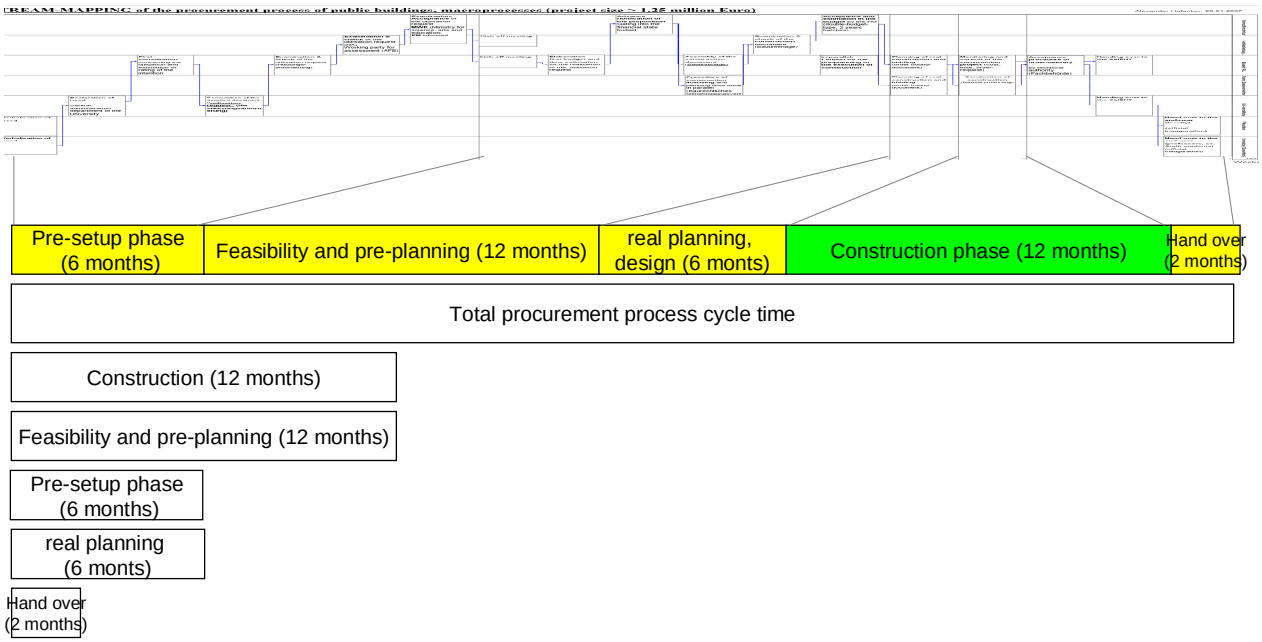


Figure 4.10 Typical process cycle time of the procurement of a public building, Schönhofen, (2007)

Due to the lack of real time measurements it is impossible to clearly identify one type of flow-operation, which is the *waiting time*, as explained in the Flow-production model and TFV-model (chapter 2, Koskela 1992, Santos, 1999). However, long process cycle times imply that waiting time is inherently included within and between the sub-processes, although it is here not explicitly observable by this simplified value stream mapping. Nevertheless the operation of *transport* (blue flashes in Figure 4.7) of material or information is visible and exists between and inside each sub-process, as project information and documents have to pass from one stakeholder to another. Hence the evaluation of this value stream map is mainly restricted to the function of "processing".

4.7. PROCESS VALUE-STREAM, EVALUATION BASED ON LEAN PRINCIPLES

The following two sections are based on the current case study reality of procurement processes and propose first propose moderate changes for a better process mapping by dividing activities into value-adding and non-value adding. Adjacently is elaborated a proposal of a new value stream (section 4.7.2).

4.7.1. Conservative modifications of the current procurement process, based on VA, NVA, NNVA categorisation

According to the lean-approach of the Toyota System (Shingo, 1996), it is important first to focus on the control of the macro process before starting optimization of single operations. Within this dissertation it implies to introduce improvements on the macro process (information and material flow), adjacently also operations may be optimized. Following the lean principles, these eighteen mapped sub-processes of the procurement value stream can be assigned to three different categories, illustrated in Figure 4.9: Value Adding sub-processes (VA, green), Necessary but Non-Value-Adding sub-processes (NNVA, yellow) and Non-Value-Adding not necessary sub-processes (NVA, red). This allocation of each sub-process towards one category is based on the following criteria:

“Value Adding” is hereby defined as a transformation sub-process that contributes productively to the satisfaction of the customer requirements here the establishment of the demanded facility. This for instance includes the formulation of the request by the demander as well as the design and execution of the construction.

Yellow marked sub-processes defined as NNVA relate to the necessary control processes as well as official hand-over of responsibility and ownership of the project or facility towards another stakeholder (for instance the final delivery of the facility).

Red-sub-processes (NVA) are the respective sub-processes of unnecessary double-checking of documents without added value, also considered as “muda” (waste).

Furthermore all blue lines in Figure 4.11 correspond to transport of information or material (documents) between different stakeholders that also require resources and are considered not-value adding flows[28]. Therefore one aim is to reduce the number of process steps and intersections of stakeholders to achieve a better process flow.

Figure 4.11 illustrates the categorized macro process[29] for procurement of public buildings.

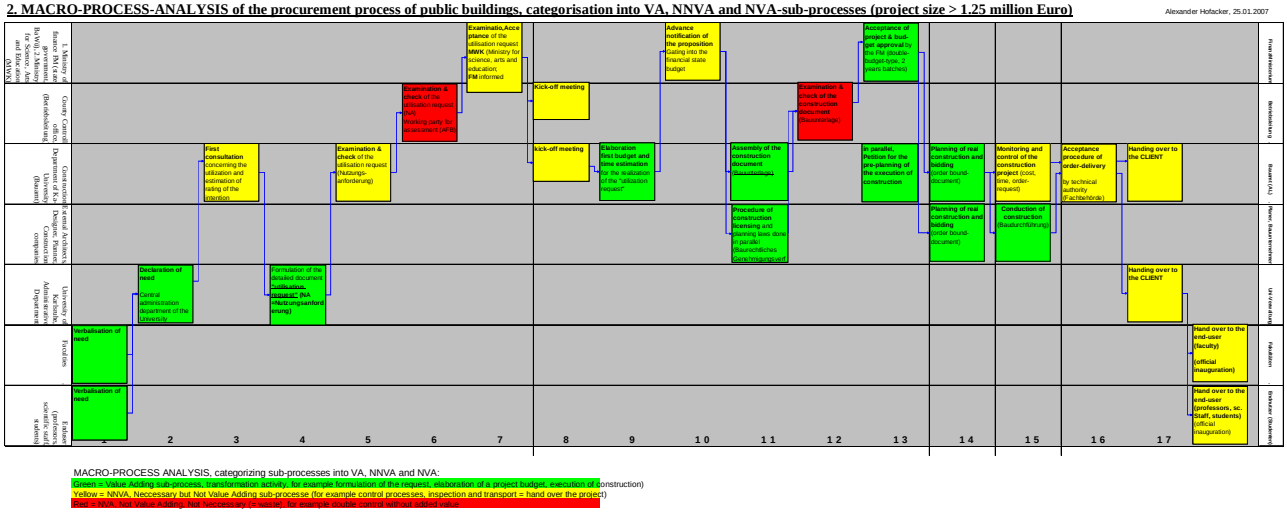


Figure 4.11 Macro-process analysis, procurement of public buildings, categorisation into VA, NNVA, NVA sub-processes

Two NVA-sub-processes are detected; first one is step 6, “examination and check of the utilisation request”. These documents are checked twice, first by the construction department and secondly by a working group of the County Control Office. The second red-sub-process is number 12, “Examination and check of the construction documents (Bauunterlage)” done by the County Control Office.

[28] The flash does not fully represent all actual flows; in reality there are many information flows back-and forth until passing from one sub-process step to the next. Nevertheless, due to simplification in the graphical form it is presented as forward-flash.

[29] Detailed argumentation for the allocation of each of the sub-processes towards yellow or green is not done here and despite the above mentioned criteria there may be some disagreement for the declarations of certain sub-processes towards yellow or green. Substantial interest to reduce lead time of yellow sub-processes conditions time measurements and the notion of waiting times, which is out of scope of this dissertation.

Declaring these two sub-process as unnecessary and not value adding is based on two arguments: As both stakeholders, the County Control Office and Construction Department work for the same ministry and have the function of being representative for the construction owner (financial ministry), there must be no double control within the same perimeter. Furthermore, for large projects the construction document (Bauunterlage) is in most cases elaborated by freelancing planners and architects due to lack of internal resources of the construction department. Therefore the construction department already acts as construction owner and control of the elaboration of these documents. A second control of the County Control Office in this case represents no added value, but time consuming double check. According to the lean-principles and objective to avoid waste, it is the proposal within a regrouped macro-process to eliminate the non value adding sub-processes (red colour, number 6 and 12).

Two more sub-processes evoke special interest as highlighted in figure 4.12; (sub-process number 9: “Elaboration of a first budget and time estimation”; and sub-process number 10:”Advance notification of the proposition” in order to gate the project into the financial state budget. Both are considered to be necessary, either as a supportive or real value adding function. As lean-principles target to simplify processes and reduce the process cycle time[30], the proposition for improvement in this dissertation is to anticipate both sub-processes. The suggestion is to integrate the elaboration of a first budget and time estimation for the utilisation request already in sub-process 5 which is a detailed examination of the same utilisation request, done by the same stakeholder (construction department). This enables also the anticipation of the advance notification of the proposition of this project (sub-process 9) to be done simultaneously with the examination and acceptance of the utilization request.

[30] Compare with chapter 2.5 : « reduction of process cycle time » and 2.6: “lean administration related to information process and procurement”

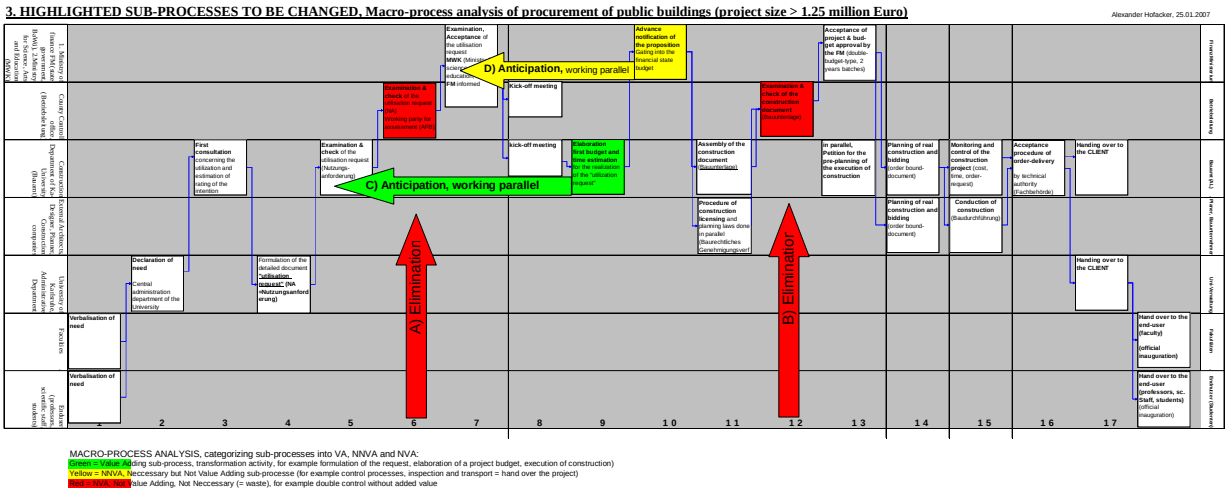


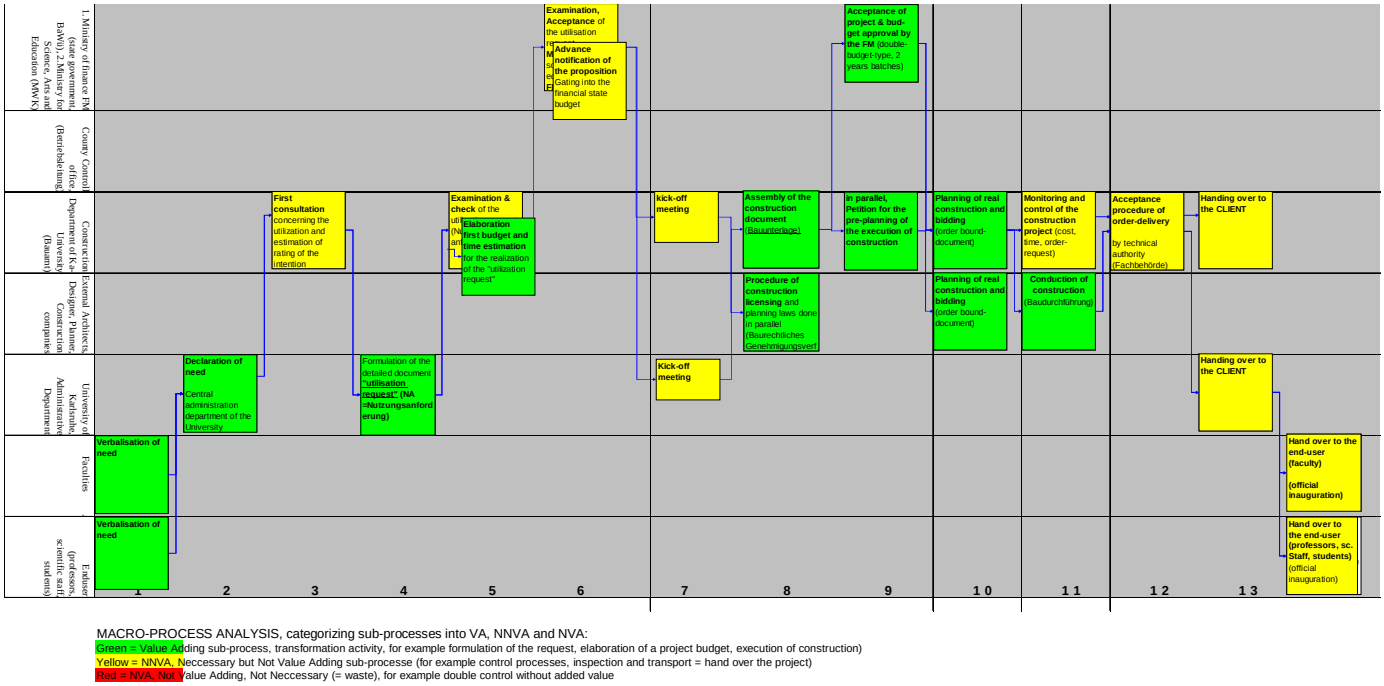
Figure 4.12 Proposition of changes in macro process

The proposal of the newly mapped process is illustrated in Figure 4.13, with the changed sequence between step 5 to step 10 explained in more detail.

Having elaborated the document of the “utilisation request”, the central administrative university department (4) sends these documents to the construction department for a detailed examination. If the project is considered as justified necessity then the construction department elaborates already at this same time a first budget and time estimation for this possible project (step 5 & 9). Now there is no need for double examination by the County Control Office (elimination of step 6).

The “utilisation request” together with the time and budget estimation can pass directly to the ministry which examines the project according to their priorities and balances the available state resources with the requested demand. The existence of time and budget estimation already at this stage enables the Ministry to better estimate the impact and priority of the respective project related to the state budget. Furthermore, in case of acceptance of this utilisation request, the project can already now (at step 7 instead of 10) be gated as a notification of the proposition into the financial state budget. Instead of organizing the kick-off-meeting (step 8) with the County Control Office, it is arranged between construction department and central administration of the University (representing the end-user). Finally the double control of step 12 is eliminated as the elaboration of construction document (Bauunterlage) is outsourced to

freelancers and the construction department absorbs the control function of the County Control Office.



MACRO-PROCESS ANALYSIS, categorizing sub-processes into VA, NNVA and NVA:
Green = Value Adding sub-process, transformation activity, for example formulation of the request, elaboration of a project budget, execution of construction)
Yellow = NNVA, Neccessary but Not Value Adding sub-processe (for example control processes, inspection and transport = hand over the project)
Red = NVA, Not Value Adding, Not Neccessary (= waste), for example double control without added value

Figure 4.13 Proposal of the macro-process for procurement of public buildings

As a result of the proposed regrouped value-stream map there are just 14 of 18 consecutive sub-processes and 6 instead of 7 stakeholders necessary for the whole procurement of public buildings.

4.7.2. Further regrouping of the value-stream, lean-proposal for the future procurement process of public buildings

The more radical lean approach for the future target procurement process is divided into two parts with two process cycles, first the pre-planning process capturing all projects within half-year cycles as illustrated in Figure 4.14, followed by the real-planning, tendering- construction and delivery phase, shown in Figure 4.15.

This process proposal implicates prior improvement propositions and builds on the approach of 14 consecutive process steps. Furthermore is defined the University Central Administration with a construction section as being the process owner of the pre-planning phase. Ownership hereby implies to act as a permanent contact entity, to follow the process, pull information and to hold certain decision power.

As the required and approved budgets within the last years at Karlsruhe University remained nearly constant between 15 and 20 million Euros, one of the main ideas is to anticipate budget approvals of the governmental ministry, to provide this budget to the central administration of the university, make the university owner and payer of the procurement of buildings.

There is no need for a county-control-office as an intermediate function between financial ministry and construction office, as the responsibility is shifted directly to the university. Mismanagement of budgets can be fined by reduction of consecutive budget allowances.

Furthermore, the cycle-time for the budget allowance of the overall construction budget of Karlsruhe University is reduced to 0.5 years and being kept constant, independent of projects. The lead time for the demand processing of each project is defined as 4 weeks as a major target.

Batch-size reduction of the budget-approval is proposed within as a first step in figure

4.14 starts with the 0.5-yearly budget allowance[31], at Karlsruhe University this represents a volume of about 9-10 million Euros. The main proposal hereby is to assign the ownership of this respective budget for projects that will come up in the next six months to the central administration of the university.

End-users, thus faculties or single persons, such as scientific staff express their needs and demand regarding constructions on campus towards the central administrative head of the university. This entity checks the request of the particular project and specifies further details so that the construction department can elaborate a budget estimation. The target lead time for this demand processing is 4 weeks.

All requests for projects with the elaborated budget and time estimations since the beginning of the year are accumulated by the central administration of the University until at the end of the second quarter this entity decides which requested projects shall be executed by matching the available resources and clients demand.

The outcome of this decision meeting is communicated to end-users and to the financial ministry as an input for the next budget allowance and the kick-off meetings with the construction department (both meetings should take place the working-day afterwards). At this stage the Governmental Ministry can still stop a project, if the decision of the University on the deployment of resources is controversial to the global education priorities, formulated by the ministry.

[31] (for instance always at the beginning of quarter 1 and quarter 3)

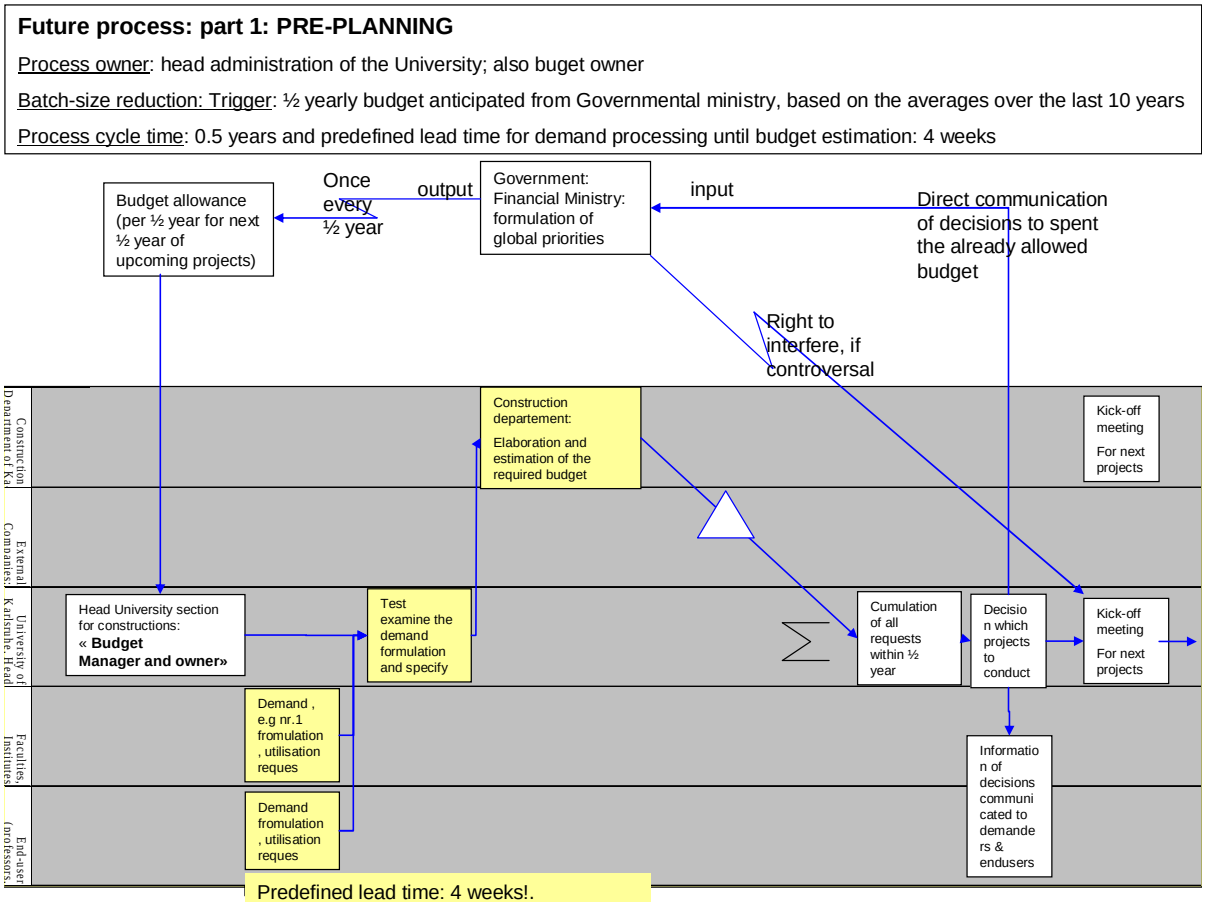


Figure 4.14 Radical proposal of the pre-planning-process for procurement of public buildings

The second part of the procurement process (illustrated in Figure 4.15) is referred to the real planning, tendering, construction and delivery of one project. Process owner is also defined to be the University, as being representative of the end-user and paying party, exceptionally for the part of the execution of the construction itself, which requires further expertise, available by the construction department. As projects refer to a size over 1.25 Million Euro, there is always one person continuously working on one project and the responsible contact person, that also follows and monitors the whole process. The kickoff-meeting conduces to set up clear targets for time, cost and quality requirements that conincide with client expectations. This meeting forms the trigger to start the real planning.

Verification of legal aspects and licensing are arranged in parallel to the assembly of

construction documents, either elaborated by the construction department or external companies. Adjacently, the University administration and construction department select the best bidders according to the requirements and budget estimations. This result is also communicated to the public (end-users).

Construction execution, acceptance procedure and delivery to the end-users is kept the same as in chapter 4.7.1. However, in order to close the process cycle of each project there is suggested a conclusive meeting between the construction party and the central head-university, to consolidate return of experiences and report the outcome to the Financial Ministry. Results can be used for continuous improvement, PDCA-cycles, indicators of reliability and benchmarking.

Figure 4.15 shows the second part of the restructured procurement process.

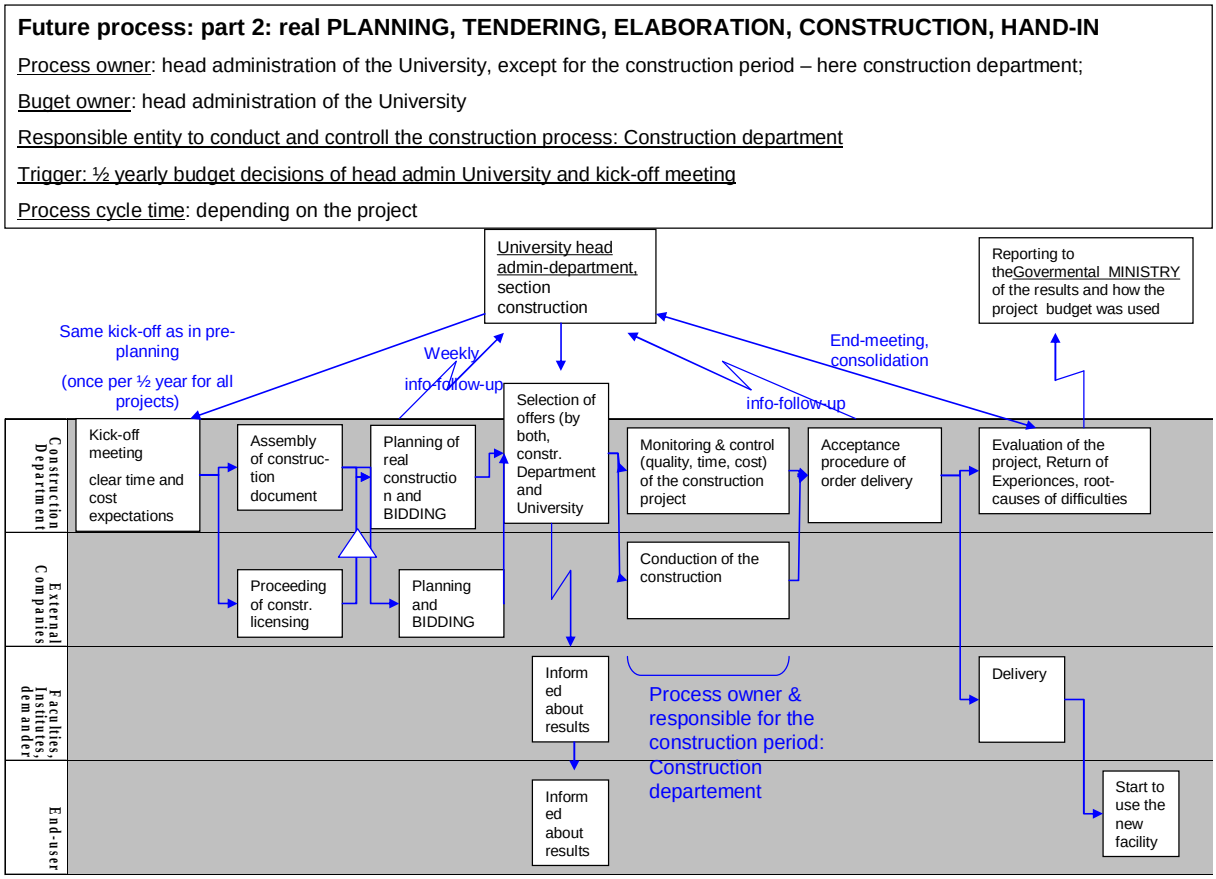


Figure 4.15 Radical proposal of the pre-planning-process for procurement of public buildings

4.8. RESULTS AND DISCUSSION

4.8.1. Applying lean principles the procurement process

Applying lean principles according to Womack & Jones (2003), (value, value stream, flow, pull, perfection) to the context to procurement of public buildings is referred to the same five categories:

A) Client and Value:

By means of the overview of lean-management principles and the TFV-model in chapter 2, figure 2.2 and 2.6 the approach initiates with the focus on the customer and what is perceived as value. The current procurement process was mapped down to 18 consecutive steps, of which some of the steps are related to double controlling and not value adding. The real value of the end-user is mainly referred to the real planning and execution phase of projects, but not to the pre-setup, preplanning steps. Nevertheless, there is the inherent question of what and how to define value by the client or end-user in the context of the procurement of public buildings and to define the intermediate customer-supplier relationships. These interrelations are complex and not yet clarified by reasons of different stakeholders and the fact that in the current situation the payer (Financial Ministry) is not the same entity as the final end-user (Professors, scientific staff, students). What is defined as value within this context is the satisfaction of a need for a new or modified educational facility expressed by end-users (e.g. students) or a university institution.

However, the question of client-supplier relationship in public context has to be further examined and transparently communicated to all stakeholders in order to clearly define the interfaces, ownership and responsibility of the whole process cycle and thereby to increase the overall value creation.

Compared with these theoretical interdependencies, there is today no conscious link

between final end-user and financing party (Financial Ministry). In contrary, both stakeholders are decoupled from each other as procurement lead-times for investment projects over 1.25 million Euros are often higher then the cycle time of end-users at university, by means of an average five-year education cycle for an engineering degree. Two other aspects of the current procurement process hinder the relationship between Government and End-user to benefit mutually from new investments:

Right to a say: The procurement-demanding party (administrative head of the university) has only a right to a say for changes in the demand until the "utilisation request" is formulated and accepted by the ministry (figure 4.7, sub-process step 7). However, the batch size of the financial state budget is triggered today on a 2 year mode. Therefore projects often need to wait for the next budget cycle (two years) only to pass the next sub-process hurdle (figure 4.8, process-step 13). In the meantime the technology standard and requirements may change, which was exemplarily the case in the procurement process of the new library building at Karlsruhe University that took more then 15 years from demand formulation until delivery in which the construction period itself lasted only for 3 years.

Feedback about client satisfaction: Today at the stage of project delivery, there is no feedback from end-users to the financial ministry or construction department. According to Schönhofen (2007), client expectations are met, if there happen to be no claims. However, value can hereby created by raising the awareness of who paid, who developed the project, for which objective and which end-users and simultaneously to initiate a process of learning-experiences and continuous improvement.

There is a need for a clearly defined process owner, here proposed the central administration because this stakeholder is closer to the end-users than the financial ministry and can directly communicate and interact with the clients (here for instance scientific staff). Furthermore the responsibility has to shift from a top-down hierarchical approach towards a further autonomous model with proper budget management at lower hierarchical levels (university itself instead of the financial

ministry). Self-responsibility of universities to decide and prioritize certain construction projects facilitates to better capture the real needs of students and scientific staff.

Control instances have to be reduced while at the same time interdependencies and responsibilities are clarified and more transparent, as proposed in the mapped process in chapter 4.7. In a future process, projects should be grouped together on the high level of governmental ministries whereas on the shop-floor each project is closely followed by one person that is purely dedicated to one project.

Modifications and changes in demand should be made possible throughout the whole process, if the University itself (central administration) is the process owner and responsible not to exceed the overall university budget. It is further proposed that the university has the right to accumulate non-spent budgets up to two years to obtain more flexibility and avoid spending budgets within two quarters purely not to loose money within the next budget allowance.

B.) Value stream: Process transparency and waste

In chapter 4.5 has been described the current value stream map of the macro procurement process and in chapter 4.7.1 was elaborated a proposal for a regrouped value stream by lean-management criteria. Today the procedure of the macro-process of procurement of public buildings is complex but clearly defined and accessible to all stakeholders by governmental publications. These governmental procedures (DAW 2002) provide certain visibility and a process mapping of respective consecutive steps serve as a first approach towards process transparency. Nevertheless the real value stream will be efficiently optimized if a task oriented micro analysis[32] follows to the macro-analysis and regrouping of the sub-process modules. Such an activity based

[32] Compare with Wiegand and Franck, lean administration, step 1, Analysis, 2005

analysis is time intense, according to Wiegand and Franck (2005) it takes six months to conduct such study for a medium company on average. The elaboration of such requires willingness, motivation and ability of all involved employees to participate; furthermore it concerns all levels of hierarchy within an organisation (Wiegand and Franck, 2005). Accordingly in doing so, there is typically found the real potential to avoid waste, which consequently leads to a number of changes within the organization due to the optimization of the business process. Gehbauer (2007) states provocatively, that "with the application of lean-principles everybody will win, except the ones that live of superfluous and waste".

Today in public administrations on a micro level there is no visibility of the lead-times and types of activities. Access and openness to conduct such an activity based analysis is not favoured in public administrations in the same way as it is in private companies, due to the lack of competition and absence of change as a prerequisite that a private company needs to face in order to remain in the market. The objective of the value stream and activity analysis is neither to blame people, nor to rationalize positions but rather to avoid waste and value-loss, to focus on the value adding activities, to simplify the process, detect bottlenecks and reallocate resources towards these bottlenecks in order to release constraints and smoothen the process.

C.) Flow, measurement of lead times

Applying the principles of the process as a flow requires the separation of the process into the four distinctive types of activities: transport, processing, waiting and inspection, as explained in chapter 2. Waiting time has no particular functional means and can be detected only through time measurements. Today the lead times of the sub-processes are not systematically measured, therefore it is impossible apply the flow model because one of the main elements is to visualize idle waiting times and to detect bottlenecks.

A first generalization of the macro processes of procurement of public buildings could be derived from a systematic analysis of all project documents of the last 10 years, referred to the dates of reception or completion. This approach only provides some macro transparency about the lead times of sub-processes which can enable to detect some queuing effects related to entities of stakeholders and may raise questions of priority criteria and speed for decision taking. Real application of the flow model becomes practical if activity based time-measurement is conducted, so to detect the real micro bottlenecks and single waiting times.

The objective of the flow-principle is to reduce the process variability[33] and cycle time. Today as explained within the interviews by Schönhofen (2007) the lead time of the procurement process depends on political priorities and these criteria for their decisions are not transparent to all stakeholders. The majority of time consumption within the procurement process is spent on preparatory activities, yet administrative costs for this preparation and for the control of respective sub-processes are hidden behind and have never been considered as directly related to the value stream.

In the future this objective could be achieved in the proposed solution of chapter 4.7.2 by predefining the process ownership, closing the process cycle[34], establishing clear objectives on lead-times and standardizing smaller and more regular batch-sizes of the budget allowances by the governmental universities. Further reduction of cycle time is then only possible if lead times are measured; adjacently, actions can be taken to reduce queuing effects and waiting time. Consequently, reduced cycle times provide higher flexibility to learn from other projects and reduce the vulnerability of process variation due to changes in demand which also leads to cost reduction.

[33] Processes in public procurement are hereby considered to be stable in terms of predefined and compulsory procedure to follow.

[34] To close the process cycle is here referred to anticipation of budget allowance, so that the output of the decisions of the university on the budget is used as input for the financial ministry to allow the next budgets. Furthermore at the end of each project there is a return of experiences and feedback to all stakeholders.

D.) Pull

The pull-principle as described by Oehmen (2005) is a basic control paradigm in which an upstream activity only starts after being triggered by a downstream activity, with the goal of minimizing complexity of the control system, lowering the through-put times and smoothen the process by avoidance of queuing effects. Pull-principles require clarified responsibilities and process ownerships, as mentioned in section A). As long as this question is not solved for the pre-set-up phase, feasibility and planning phase, the procurement process will always remain in push-situation. Push mode in procurement today means that although the overall process is defined, each person at the respective work place works off his tasks and sub-processes according to the predefined procedure and sends the work to the next stage, no matter what is happening downstream and with no time indication until when to finish the task. Queuing effects and bottlenecks are here not visible to the stakeholders. In other words, until the final budget approval (figure 4.8, sub-process step 13) there is no process owner, nobody of the stakeholders is directly responsible for the value stream by holding the function of being representative for the requests of the end-user. Therefore lead times of these first sub-processes depend on the priority, work-load and goodwill of each stakeholder.

An exemption is the sub-process of the construction phase, where the construction department is declared as process owner with the function to control the executing companies according to the combined price, quality and delivery time. The prevailing project planning and management method is hereby done with the help of Work Breakdown Structures WBS; Figure 4.16 illustrates the current push-situation in the procurement process.

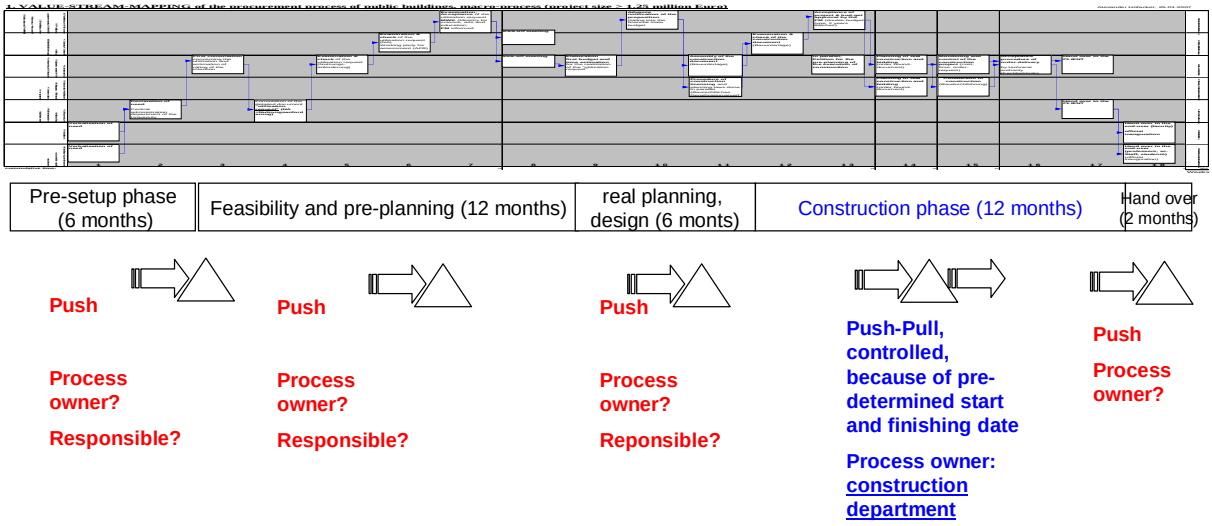


Figure 4.16 Current situation of the macro process, push-pull situation

Introducing pull-effects on the procurement process of public buildings can be obtained through the empowerment of the university as process owner, through restructuring of the whole process (as done in 4.7.2) and by establishing predefined targets on certain lead times. Also the fact that one person of the university is dedicated full-time to follow one project enables to pull information or documents from one process step to the adjacent step. However, in the proposed solution the pre-planning process is decoupled on a pre-defined ½ year basis from the real-planning, tendering, execution and delivery process. This separation is suggested in order to group project together in an early stage, to achieve a simplified budget management and facilitate decision making on priorities of projects for the university.

E.) Perfection

Continuous quality improvement and pursuit for perfection is the last mentioned lean-principle. Related to the procurement, it is referred to continuous search for waste and improvement for public administration to provide transparency, measure lead times

and focus on the value provided to the customer and end-user. One of the main obstacles to integrate learning- and PDCA[35]-cycles into the procurement is related to the current tendering process for all projects that are financed by public administration in Germany. Public tendering is by law compulsory for any construction project financed by public administrations in order to provide equal conditions for bidding companies without any preference except for the lowest price referred to requested quality. The downside is that the lowest offered price for certain construction projects does often not refer to the value creation and end-user focus, but tends to evoke management of claims (Gehbauer, 2007). Furthermore contractual partnering and learning cycles with external construction companies is impossible due to constant changes of companies for each project, evoked by public tendering. In Germany there is further research and development of sustainable concepts for the tendering process required (Gehbauer, 2006).

However, a basic constitution of continuous improvement can be achieved by accomplishing an evaluation and consolidated feedback meeting at the end of each project with the two main stakeholders (construction department and central administration of the University). The objective is to capture, evaluate experiences and adjacently to report the results to the higher hierarchies (financial ministry).

4.9. SUMMARY OF PROPOSALS

In the beginning of chapter four is explained the context of the case study, the organisation of the university construction department and the procurement process of public buildings. The yearly budget for maintenance and construction of this administrative entity includes on average 5-10 projects with an investment higher then 1.25 million Euros, considered as large projects. For this type of projects is made a

[35] PDCA = Plan, Do, Check, Act; this principle stands for continuous improvement cycles.

value stream map of the current procurement macro-process. Despite lack of measured lead times it can be derived from experiences and the mapped macro process that pre-set-up and planning phase is significantly longer then the actual construction phase. Adjacently, implications of lean thinking are conducted on the mapped value stream, categorizing the detected sub-process into VA, NNVA and NVA functions and restructuring the process-mapping according to lean-optimization principles (4.7.1). The proposal of a more radical restructuring of the procurement process is further divided into two process cycles (4.7.2), with the **first cycle considering the pre-planning phase of demand processing.** Here the major changes are the following:

- process ownership defined (central University) and closed process cycle
- process trigger: budget allowance of the financial ministry and project-decision day of the university
- responsibility and budget management conducted by the University, which is considered to be closer to the “shop floor”
- process cycle time defined (0.5 years) and predefined lead-time to pass through the demand-processing and budget estimation (4 weeks)
- no need for a county control office
- anticipation of budget allowance on 0.5 year basis by the financial ministry, based on averaged budgets of former years and general education priorities

Second process cycle starts with the kick-off meeting to start the project, followed by **planning activities, tendering, construction execution and delivery** to the end-users.

Suggested changes in this part are the following:

- process and budget ownership defined: University (central administration,

section construction)

- no double acceptance of the project needed by the Financial Ministry and elimination of 2-year budget cycles
- End-users (faculties, scientific staff) are better integrated in the process (communication at 4 stages of the procurement process)
- Possibility to modify the demand until latest stage
- Clear information flow and responsibilities defined
- Value-stream followed by the process owner; here one person is dedicated to follow one project (pull information)
- Closed process cycle: to organise a consolidation meeting at the end of each project; here to evaluate the project, capture the return of experiences and propose improvement for future projects. (purpose: reporting, benchmarking, continuous improvement)

The last chapter concludes this dissertation and provides an outlook with suggested areas for future research.

5. CONCLUSION

This dissertation demonstrated that the associated research hypothesis is correct in saying that lean principles are not yet applied in governmental organisations. This turned out to be true first as even the term “lean-management” was not known to the interviewed people and second by the results of the mapping of the current procurement process. The procurement process on public buildings (large scale construction projects) is today not designed according to the value-stream but contains a lot of waste, long cycle times and there is also a lack of process transparency to the stakeholders. Within this research were detected several points of possible improvement through application of lean principles. Process mapping and value-stream mapping showed potentials of waste and how to focus on value in procurement.

The objective of this dissertation was to propose a leaner model of the procurement of public buildings on a macro process-level. Therefore lean principles are first elaborated by means of a literature review. The current procurement process was mapped within the case study, containing 18 main consecutive steps and is related to 7 different stakeholders. Transition from lean-principle approaches could be maid by analyzing value and non-value adding activities and regrouping the value-stream and reducing the interfaces and number of process steps.

Process cycle times for procurement in public buildings are today considered to be high but they’re even not measured, which hides bottlenecks and queuing effects. Based on insights from the construction department the actual construction phase is mostly related to less than one third of the overall procurement process cycle time. The customer-supplier relationships and process ownership of all the sub-processes are today not clarified to the stakeholders. Therefore exists a lack of value-perception and the activities are in a push working mode.

Reduction of cycle time and costs can be achieved, based on the assumption that a significant reduction of process steps, less interfaces between stakeholders, defined

process-ownership and batch-size reduction of governmental budgets will provide these results of cycle time and cost reduction.

General remark:

This improvement approach on procurement processes is derived from official government procedures and semi-structured interviews, therefore it has to be seen in the context of the respective project and administration entity. Thanks to deeper insights into the governmental construction department at Karlsruhe University it was possible to provide understanding of the current administration departments and stakeholders that are involved in the procurement process. The expertise and working effort of the people of this construction department is by no means questioned in this dissertation.

Nevertheless, the procurement process starting from demand formulation until the final delivery of a public building to the end-user is defined by the government in terms of procedures to be followed and it seems that the process as a whole has been neither from a client-value perspective, nor from a process-flow perspective ever thought through.

At the same time governmental administrations are considered as controlling institutions and cost centres rather then service providers. This mindset is reflected by governmental activities of constantly decreasing the number of employees within these construction departments over the past years, in order to reduce costs and hereby assuming to “lean” the administration. As construction budgets remain constant, external freelancers need to be hired. This in reality increases the complexity of the procurement process because of compulsory public tendering for each project and sub-contract above 7500 Euros (interview, Schönhofen, 2007). Concluding this dissertation, a real “lean” approach is here based on the five lean-principles of value creation by Womack & Jones (2003) by focusing on the customer, simplifying the

process and allocating resources towards bottlenecks of the process to reach a better process flow and value-stream, higher transparency and reduced cycle times. Therefore a new process and implications of lean thinking on this process was proposed in section 4.7.2 and 4.8. Now the challenge is to convince politicians and decision makers to change structures of responsibilities and to imply lean principles in public administration without misunderstanding or misusing this term to cut jobs. The objective is to put the real meaning of “lean” into practice in order to simplify processes, reduce waste and better allocate resources towards their added value for the end-user.

6. FUTURE OUTLOOK

The relevance of this dissertation in international context is related to other countries beyond Europe by means of possibilities to compare procurement processes in public buildings. The hereby suggested international outlook is to conduct a counterpart study on the procurement process of buildings in other countries. A comparative study between Brazil and Germany for instance could benefit in an exchange of best practices (including tendering processes and lead times).

Other outlook areas for future research are related to the German system, deepening the analysis into the following directions:

- Conduction of an **activity based analysis of the micro-processes and time measurements** of activities; therefore needs to be elaborated a model that is adequate for the context of public administrations; prerequisite: openness and willingness to participate
- Investigation and **clarification of the client-supplier relationships**, inter-dependencies and possibilities to close the client-satisfaction cycle, combined with marketing strategy and an elaboration of a change-management model for public administrations.
- **Batch size reduction of the governmental state-budgets** (instead of 2 year-buckets, half-year buckets – to fasten the process; analysis and elaboration of a sustainable (economic, end-user and production oriented) model.
- **Tendering and contracting with public administrations**, elaborate a new concept for administrations to achieve restricted tendering for construction projects. This concept could be based on comparative studies with tendering proceedings in Germany, UK and Brazil.

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GLOSSARY:

Definitions:

Project management: *"The overall planning, control and coordination of a project from inception to completion aimed at meeting a client's requirements and ensuring completion on time, within cost and to required quality standards".* Defined by C.I.O.B., 1988, Chartered Institute of Building, Project Management in Building, found in "The work of F.B. Gilbreth and its relevance to present day construction management, D.W. Cheetham, et al, 1991

Lean administration: *"Lean administration is defined as the application of lean management approaches and methods to the area of business processes, irrespective of whether they take place in a company or an administration institution."* Found in "lean-administration", part1, Analysis, B. Wiegand, P. Franck, 2005

Process: *Process refers to the flow of products from one worker to another, that is, the stages through which raw materials gradually move to become finished products. Found in the* "Toyota Production System", Shingo, 1998.

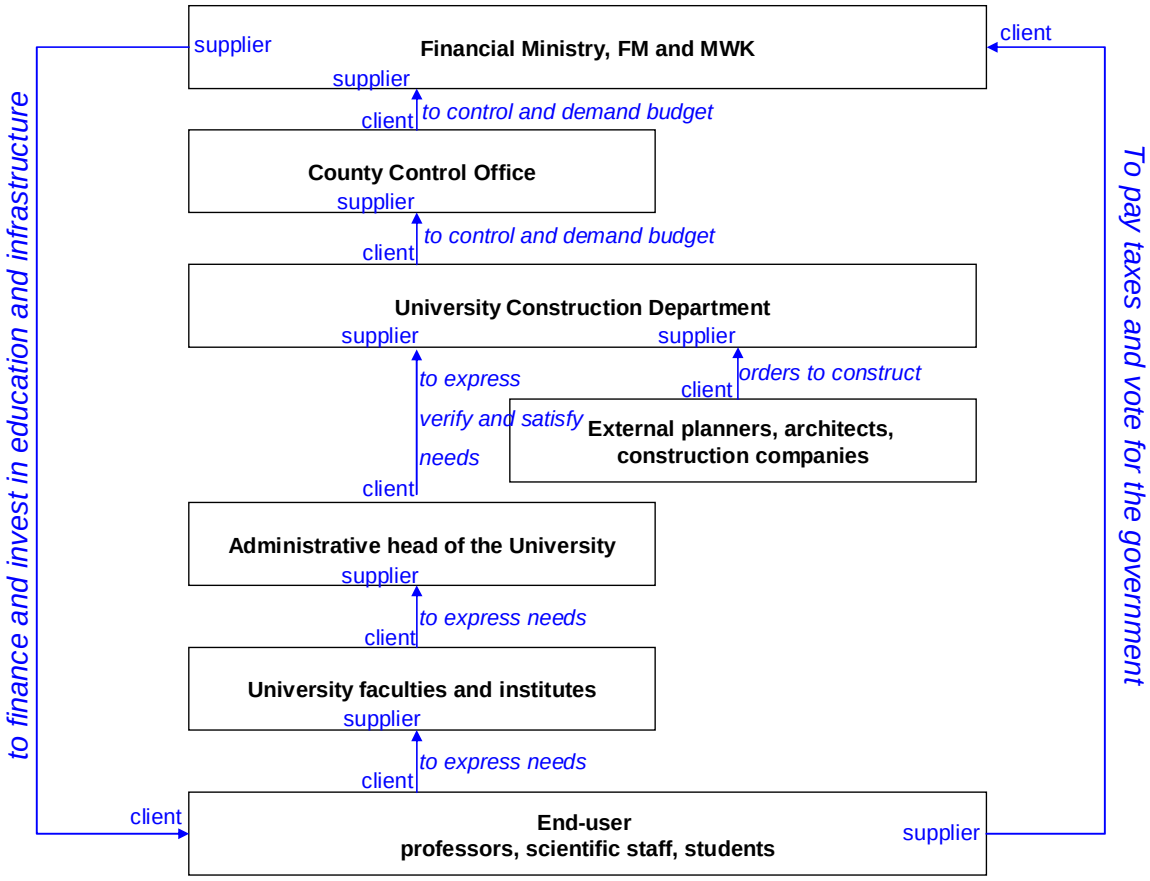
International ISO 9000:2000 standard for quality management systems: *a process is a set of interrelated or interacting activities, which transforms inputs into outputs.*

Operation: *"Operation refers to the discrete stage at which a worker may work on different products, i.e. a human temporal and spatial flow that consistently centres around the worker." Found in the* "Toyota Production System", Shingo, 1998.

APPENDIX

The theoretical customer-supplier relationship of today is elaborated in the following figure, illustrating the analysis of the client-supplier relationships of procurement of public buildings how it "should be today", derived from information of the semi-structured interviews with the construction department. This figure is not explicitly available in the literature, therefore not put in the body-text, but it corresponds also to the prevailing understanding of the governmental procedures for the public construction project approval (DAW, 2002).

Customer-Supplyer-Relationship; procurement of public buildings



1. Summary of first telephone interview:

Telefongespräch mit Herrn Schilling, 29.10.2006

Kontaktdaten:

Es gibt zwei Abteilungsleiter für das Bauamt-Bereich Uni-Karlrsuhe

Herr Schilling: Abteilungsleiter Tel: 926 5865
Herr Schönhofen: ebenfalls Abteilungsleiter

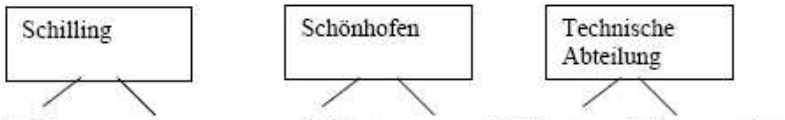
Am Telefon signalisierte mir Herr Schilling Offenheit gegenüber meinem Vorhaben, betonte aber, dass sie mit mir nicht zuviel Zeit verbringen können.

Ich erklärte ihm, was für mich interessant ist:

1. die Organisationsform verstehen, wie Abläufe und Prozesse ablaufen
2. Ein Beispielbauprojekt näher zu betrachten.

Zur Organisationsform erklärte er mir bereits:

Bauamt-Universität Kalruhe: Organisationsaufteilung



Der „normale Antrags und Planungsvorgang" für Bauvorhaben der Universität Karlsruhe:

1. Phase: Der Nutzer (Universität) formuliert einen Bedarf (Antragsschreibung)
   Wer?
   Wie?
   Wo?
   Zeit…
2. Der Antrag wird vom Ministerium geprüft (komplexe und vielfältige Verfahren)
3. Das Land vergibt Prioritäten bezüglich der Projektdringlichkeit
4. Wenn der Antrag genehmigt, dh Gelder freigegeben werden kommt es in die Planungsphase

Planung:
Hierfür ist das Bauamt zuständig, der Auftrag wird ausgeschrieben und meistens an einen Architekten vergeben. Sowohl Planung alsauch Fachingenieure werden unterbeauftragt.
Jetzt kann die Universität nicht mehr eingeschalten werden, z.B. wenn Änderungswünsche von der Universität noch kommen. Die Überwachung der Abläufe findet durch das Bauamt statt.

Zeitdauer, Beispiel:
Im Falle des Um- und Neubaus der Universität dauerte es 25 Jahre von Antragstellung bis Fertigstellung.

2. Questionnaire used in both physical meetings:

ORGANISATIONSANALYSE, Fragebogen Bau-Amt TH Karlsruhe

Betreff: Lean Management, Lean Administration, Lean Construction
Fragebogen im Zusammenhang mit der Masterarbeit

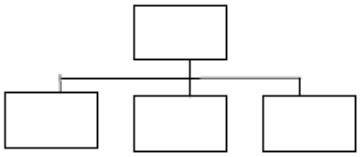
1. Unternehmensstrukturanalyse:

ANALYSE Schritt 1:
1.1 Organisation:
1.2 Personalwesen
1.3 Kunden
1.4 Konkurrenz
1.5 Stärken und Schwächen

a) Organisationsform

Dienstvorstand:	Meissner, Bernd-Dietrich, Lt.Baudirektor
Stellvertreter:	Waldern, Horst, Regierungsdirektor
Abteilungsleiter1:	Jungk, Helmut, Oberamtsrat
Beauftr. Für den Haushalt:	Schmitt, Hans-Peter, Techn. Angestellter
Vorzimmer:	Beer, Chistine

Zeichnung- Organigram (direkt des Amtes, sowie deren Zugehörigkeiten und Abhängigkeiten:



Unternehmens-bereich (business occurence)	Priorität (Priority)	Verantwortlicher für den Prozess (process responsible)	Umsatz /Jahr (turn over)	Häufigkeit Der Prozess-tätigkeit/Jahr e.g. Bauprojekt (frequency)	Durch-Laufzeit (troughput time)	Prozess-Kosten (process costs)	Preis/ Ertrag (Price /Revenue

ORGANISATIONSANALYSE, Fragebogen Bau-Amt TH Karlsruhe

b) Personalwesen des Bau-Amtes

Personalkosten (inklusiv Material und Zusatzkosten – das ist wichtig um später die Prozesskosten während der Kostenstrukturanalyse zu berechnen).

Stelle	Position /Verantwortlichkeit	Anzahl	Lohn/Stunde	Gehalt /Lohn-Kosten
A	Dienstvorstand	1		
	Stellvertretender Dienst-vorstand	1		
	Abteilungsleiter1	1		
	Beauftr. Für den Haushalt	1		
	Vorzimmer	1		

(oder über Gesamtkosten der Abteilung errechenbar)

c) Kunden

- Wer sind die Kunden? (Jeder Nutzer eines Services ist Kunde)

WER IST ANSPRECHPARTNER (KUNDE)? Universitätshauptverwaltung 5.

Fragen an die Universitätszentrale (=Auftraggeber des Bauamtes)

- Was sind die Wünsche und Anforderungen der Kunden?
- Kundenbetrachtung mit AQIC (Availability, Quality, Individuality, Cost = Verfügbarkeit, Qualität, Individualität, Kosten)
- Verfügbarkeit: Kürzeste Projektdauer:_____
  Längste Projektdauer:_____
- Qualität: Was sind die Qualitätsanforderungen bezüglich
  - Liefer- /Abgabedatum
  - Qualität (gibt es Qualitätsgrundsätze- Bestimmungen)
  - Informationen und Kommunikationshäufigkeit
  - Versorgungsbedingungen
- Individualität
  Was sind die spezifischen Wünsche/Vorstellungen und Anforderungen bezüglich auf den Service und die Dienstleistungen?
- Kosten:
  - Preisvorgaben
  - Aufwand
  - Kosten

ORGANISATIONSANALYSE, Fragebogen Bau-Amt TH Karlsruhe

d) Konkurrenz

Gibt es Konkurrenz?

Was ist ihr Angebot?

Bau-planer im freien Markt? Welche… - Vergibt die Universität auch direkt Aufträge und Planung an andere Organisationen ausser dem Bauamt?

Marktposition?

e) Stärken und Schwächen-Analyse der Organisation: SWOT

Stärken (Strengths)	Schwächen (Weaknesses)
(innere und unternehmensbedinte Faktoren)	(innere und unternehmensbedinte Faktoren)
Möglichkeiten und Chancen (Opportunities)	**Gefahren, Bedrohungen (Threats)**
(externe, d.h. markt und umweltbedingte Faktoren)	(externe, d.h. markt und umweltbedingte Faktoren)

Stärken:
Was ist die Geschichte des Bau-Amtes?

Was sind die Vorteile dieser Organisationsform?

Was sind die Chancen und Möglichkeiten des Amtes in der Zukunft?

Worüber ist das Amt insbesondere stolz, das erreicht wurde?

Schwächen:
Welche Bereiche im Amt verursachen Schwierigkeiten?

Welche Unterbrechungen/Störungen gab es früher im Bauamt?

Welche Schwachpunkte müssen in Zukunft vermieden/umgangen werden?

Welcher Teil des Amtes ist schwach im Umsatz? Bzw wird Umsatz definiert – wenn nein, wie könnte man Umsatz für das Bauamt definieren?

Möglichkeiten und Chancen:
Welche Ausbaumöglichkeiten und Chancen bietet die TH-Karlsruhe dem Bauamt?

Gibt es Möglichkeiten in den externen Baumarkt z.B. als Planungsbüro zu gelangen?

Welche unberührten Potentiale hat das Amt noch?

Welche Trends sollen eingeschlagen werden?

ORGANISATIONSANALYSE, Fragebogen Bau-Amt TH Karlsruhe

Gefahren:
Bestehen irgendwelche allgemeinen oder Markt-bezügliche Probleme? E.g. dass Bundes-/landesgelder gestrichen werden, Bauflaute…. Sonstiges?

Gibt es Konkurrenz – wenn ja, was macht die Konkurrenz?

Werden irgendwelche Veränderungen aufgrund von technologischen Veränderungen erwartet?

2. Arbeitsplatzanalyse:

Quantifizierung von Aufträgen und Identifizierung der wesentlichen Produkte.
ABC Analyse:

- wieviele Projekte hat das Uni-Bauamt mit der Universität in 2005 und in 2006
- Bausumme (ca 17M€)
- Durchschnittsgröße eines Projektes
- Durchschnittsdauer – und welche Zeiten betrachten Sie?
- Was sind die Saisonbedingte Schwankungen? (Legislaturperiode? Oder Jahreszeiten?)

Produkt	Geschäftsvorvall	Umsatz (bzw Bausumme)	Häufigkeit/Jahr	Wieviele Mitarbeiter vollzeit und teilzeit
Grosse Bauprojekte	Bsp			
Mittlere Bauprojekte	Bsp			
Kleine Bauprojekte	Bsp			

Zuerst eine Work-Breakdown-Struktur durchführen bezüglich der verschiedenen Aufgaben und Aufträgen:

XYZ Analyse
Wie ist die Verteilung der Projekte über ein Kallenderjahr (Eingang und jeweilige Dauer)

3. Wertstromanalyse: Value-stream-mapping

A) Analyse der Haup- und Neben-Prozessniveaus

Dieser Überblick der gewichteten Unternehmensvorkommnisse wird gebündelt in der Wertstromanalyse (wo und wie ist der Wert im Unternehmen erstellt)
Der Wertstrom wird visuell dargestellt

To do, Flussdiagramm wie auf Seite 76; 86; 89

ORGANISATIONSANALYSE, Fragebogen Bau-Amt TH Karlsruhe

1. (Kundendaten: wie viele Aufträge wurden für ein bestimmtes Produkt empfangen? Wie ist die Vorraussagewahrscheinlichkeit? Ist es ein XYoder Z Produkt? Wie ist die Durchlaufzeit für das Produkt in der Organisation?
(e.g. Standardprojekte, in wie viel Mann-tagen ist die Dienstleistung abgeschlossen?)

2. Beteiligte Funktionen / Stellen eintragen
3. Feststellen der prozessauslösenden Stellen
4. Grundlegende Prozessschritte aufnehmen
5. Prozessschritte Schnittstellen und Informationsflüsse bewerten
6. Den externen Material und Dienstleistungsfluss aufnehmen
7. Auftragen der **Zeitlinie** mit Prozess und Durchlaufzeiten
8. Massnahmen ableiten

B) detaillierte Prozessanalyse (auf Aktivitätsniveau)

4. Prozess-Feinanalyse

Innerhalb der erfassten Teilprozesse werden alle relevanten Einzeltätigkeiten erfasst und dokumentiert.
Fokus liegt hier jetzt nicht mehr auf der Wertschöpfung sondern Ansätze zu finden, um den Prozessablauf (FLOW) in sich verbessern zu können.

- Inhalt: Analysediagramm mit Aktionskasten
- Verschwendung aufdecken durch
    a) Prozessblitz-Tabelle
    b) GRIQ-Potenziale, dh Reduzierungsfokus auf nicht wertschöpfenden Aktionenen
    c) Schnittstellen und Medienwechsel betrachten
    d) Zeitlücken

5. Tätigkeitsstrukturanalyse (TSA)

6. Sofortige Umsetzung

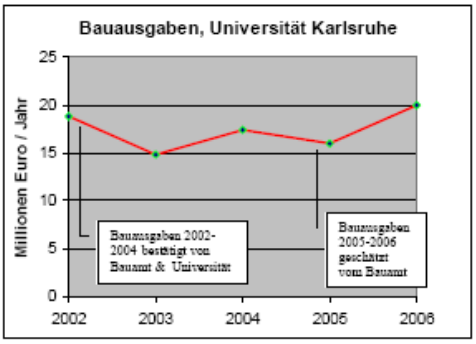
3. Summary of first physical meeting at the construction department:

Zusammenfassung der 1. Besprechung am Universitätsbauamt Karlsruhe 25.01.2007

Teilnehmend: Herrn Schönhoffen (Abteilungleiter, 926), Herrn Wipper (Ingenieur, Projektgruppe 926 5872), Herrn Hofacker (Student).

Kernpunkte, Zusammenfassung:

- **Wurde schon einmal eine Prozessanalyse gemacht?** (vor zwei Jahren, Architektur, im Rahmen der Bauunterhaltung), ansonsten ist die Vorgehensweise in der DAW geregelt und es gibt keine Ausnahmen;
- **Organisationsform**:....
- **Vorteil dieser Organisationsform**: Bauprojekte für die Universität haben einen grossen Verwaltungsaufwand und insbesondere die Mittelvergabe des Landes direkt über ein freiberufliches Büro abzuwickeln würde sich schwierig gestalten (da i.d.R. Privatkunden von solchen Büros „fachunkundige" Bauherren darstellen; die Kontrolle wäre schwieriger).
- **Tendenz der Mitarbeiterzahlen**: Rückgang der Mitarbeiterzahlen innerhalb der letzten Jahre (ca halbiert, Stellen wurden nicht mehr neubesetzt); dadurch werden heute teilweise bei Personalmangel und v.a. bei Grossaufträgen Teilarbeiten an Dritte (Freiberufliche) weitergegeben (Ausführungsplanung, Ausschreibung, Bauleitung, ggf. auch Entwurfsplanung); in der Regel wird aber die Bauunterlage vom Bauamt selbst erstellt.
- **Aufgaben des Universitätsbauamtes** und Selbstverständnis (Abteilung 7, 8 und teilweise die Technische Abteilung): Bauherrenfunktion gegenüber dem Land (Finanzministerium, Geldgeber), technisches Know-How und Bearbeitung von Nutzungsanfragen und Bauüberwachung.
- **Kundenverständnis**: Der „Kunde" ist in diesem Fall die Universitätsverwaltung (Hauptabteilung 5, als Zentralstelle für Bauanfragen von Fakultäten)
- **Konkurrenz**: es gibt keine Konkurrenz, (eventuell von den Landesentwicklungsgesellschaften)
- **Zeitdauer von Projekten**: die Zeitdauer für ein Projekt ist im Wesentlichen abhängig von der Grösse und „politischen" Dringlichkeit (Bsp. Nanotechnologie – Universitätsbibliothek);
- **Projekte und Bauausgaben** (direkt mit der Universität verbunden)



Initiative der Projektbeantragung: Entweder von der Universitätshauptverwaltung beantragt (z.B. Neue Bibliothek), oder vom Bauamt selbst beantragt (z.B. bei Schadstoffsanierungen, Brandschutz oder Baumassnahmen aufgrund von Aenderungen in der Gesetzgebung).

Ziel meiner Analyse: Darstellung und Verständnis der Projektantragstellung für den Bereich Bau an der Universität Karlsruhe, dh Genehmigung, Planung und Baumanagements; Aufgliederung in Durchlaufzeiten, - anschliessende Ueberlegung: welche Prozesse sind fassbar und wert der Veränderung, unter der Annahme man könnte den Prozess verändern (Herangehensweise nach den Prinzipien und Micro-methoden des Lean-Managements).

4. Summary of the second physical meeting at the construction department

Zusammenfassung der 2. Besprechung am Universitätsbauamt Karlsruhe 05.02.2007

Teilnehmend: Herrn Schönhoffen (Abteilungleiter), Herrn Wipper (Ingenieur, Projektgruppe 926 5872), Herrn Hofacker (Student).

Kernpunkte, Zusammenfassung:

- **Budgetaufteilung 2006, wieviel davon wurde in Neubauten investiert, wieviel in Brandschutz/Unterhaltung**? Kann unterschiedlich sein, in der Regel aber 60% initierte Projekte durch Nutzerinitiativen und 40% initiiert durch das Uni-Bauamt.
- **Kommunikation:** Welche Art der Kommunikation is gewählt bei der Zusammenarbeit und Erstellung der Nutzungsanforderung? Alle 3 Monate findet ein Bau-Technik-Treffen mit der Universitätshaupverwaltung statt; ansonsten ist Kommunikation über Telefon, E-mail und Hauspost geregelt.
- **Arbeitsaufteilung, Arbeitsweise:** Wie sind Projekte bearbeitet und den Mitarbeitern zugeteilt? Arbeitsweise in einer Gruppe an einem Projekt und erst nach Abschluss das nächste Projekt, oder Spezialisierung der einzelnen Mitarbeitern und Führen von mehreren Projekten gleichzeitig?
    - Projekte sind gebietsmässig aufgeteilt nach Gebäuden (Unicampus), dh ein Mitarbeiter bearbeitet alle aufkommenden Projekte in seinem „Bezirk". Dennoch ist innerhalb einer Abteilung eine flexible Mitarbeiterzuordnung möglich, wenn Bedarf besteht.
- **Templates: Werden bei der Bedarfsanmeldung elektronisch vorformatierte Templates verwendet?** Ja – es werden elektronische Formblätter verwendet, für die Bereiche Finanzwesen, Flächenbedarf und Auftragsschreiben
- **Haben Sie schon einmal von Lean-Construction gehört**? Nein, aber Projektsteuerung spielt beim Bauamt eine grosse Rolle.
- **Kundenbefragung**: Machen Sie nach der Gebäudeübergabe auch eine Kundenbefragung, wie zufrieden er mit dem Produkt ist? Nein, - es findet automatisch statt, laut Bauamt – wenn ein Kunde nicht zufrieden ist, dann meldet er sich.
- **Eigene Einschätzung, was funktioniert derzeitig gut, was könnte verbessert werden?** funktioniert die derzeitige Form der Gebäudebeschaffung gut, wenn ja, was? Die Form ist gut, es wäre allerdings gut die Genehmigungs und Haushaltsfristen zu kürzen und eine bessere Koordination von Hochbau und Technik zu erreichen. Bemängelung: - Nach eigenen Bauamtsangaben: Obwohl die Zielsetzung der öffentlichen Verwaltung u.a. Verschlankung beinhaltet, kommen immer mehr Verwaltungschritte hinzu.
- **Regelmässige Zusammenarbeit mit Baufirmen/öffentliche Ausschreibung**: Arbeiten Sie mit gewissen Baufirmen oft zusammen, oder findet ein ständiger Wechsel statt? – Ständiger Wechsel, da aufgrund gesetzlicher Vorgaben jede Baumassnahme > 7500 Euro als öffentliche Vergabe ausgeschrieben werden muss.
- **Es findet immer eine offene Vergabe statt**
- **Was sind die Zielvorgaben des Bauamtes**? (Zeit, Preis oder Qualität?) Laut Bauamt liegt es im Eigeninteresse möglichst schnell Projekte abzuwickeln, es muss aber alles öffentlich ausgeschrieben werden (zeitintensiv) und letztlich soll ein guter Qualitätsstandard erreicht werden. – d.h. aufgrund öffentlicher Vergabe: 1. Preis, 2. Qualität, 3. Zeit)
- Wurden **Zeiten von der Projektbeschaffung** oder zumindest Projekt-Bauzeiten dokumentiert und systematisch erfasst? Nein, bisher nicht.
- Was sind Ihre **Schätzungen**:

	Anzahl	Durchschnittsdauer
Gross-projekt	5-7	>2 Jahre
Mittel-projekt	10	1-2 Jahre
Klein-projekt	15	< 1 Jahr
Mini-projekt	700	Mehrere Wochen

Die Wartezeiten hängen im Wesentlichen von der Bedeutung (politischen Priorisierung) des Projektes ab.

- **Benchmarking**: Vergleiche mit anderen Bauämtern und Zielvereinbarungen mit der Betriebsleitung: Es gibt Benchmarking mit anderen Bauämtern, dabei wird das Bauamt Karlsruhe im „forderen Mittelfeld" eingestuft