

31 recommendations for increased profit

Reducing waste

PER-ERIK JOSEPHSON AND LASSE BJÖRKMAN



CHALMERS

31 recommendations for increased profit

Reducing waste

PER-ERIK JOSEPHSON AND LASSE BJÖRKMAN



CHALMERS

31 recommendations for increased profit

Reducing waste

PER-ERIK JOSEPHSON AND LASSE BJÖRKMAN

Copyright © 2011 Per-Erik Josephson and Lasse Björkman

ISBN 978-91-979440-1-4

Print: Chalmers Repro

The Centre for Management of the Built Environment

Chalmers University of Technology

SE-412 96 Göteborg

www.chalmers.se/cmb | Tel: +46 31 772 10 00

Table of content

Preface	7
Preface to the English version	8
Abstract	9
Part I: Challenges and Opportunities	11
1 Big challenges and a higher level of ambition	13
The desire to cut costs	13
Companies raise their level of ambition.....	14
Increasing profitability and competitiveness	15
Other effects of less waste.....	15
2 Waste reduction generates much optimism	21
The concepts cost and waste.....	21
The real cost structure – do not forget the suppliers!	22
How much waste is there?	23
The mental maneuvering space.....	24
3 Large risks and uncertainties	27
A complex system that causes waste	27
Large uncertainties create significant resource consumption	29
Building and construction projects often at a standstill	30
Thirty one recommendations for increased profitability.....	31
Part II: Recommendations for increased profitability	33
4 Standardize products and processes	35
Standardize the product whilst taking into account its life cycle	35
Define and standardize the process.....	38
5 Develop the organization and its capabilities	47
Develop the organization and its competence	47
Discipline management.....	51

6 Implement gradual improvements	55
Measure to uncover of waste and to control improvement measures.....	55
Use experience to streamline resource use.....	56
Part III: Conclusions and Reflections	59
7 Conclusions	61
Lead and structure to reduce waste (What?)	61
Obviously everyone is responsible for reducing waste (Who?)	62
Learn to recognize waste (How?)	63
8 Some reflections	67
How much can we actually improve?	67
Shall we emulate the Japanese management style, or the American, or ...?	67
Understanding waste creates new business opportunities.....	69
A sense of freedom and the competitive situation?	70
9 References	73
Appendix 1: 31 recommendations.....	75
Appendix 2: Identify your strengths and your weaknesses	79

Preface

This report concerns actions that individuals and organisations could and should take to eliminate waste, i.e. eliminate tasks that are performed but that do not add any value to the customer. The primary purpose is to support and encourage individuals and organisations in their efforts to reduce waste, to lower building costs and to improve their day-to-day life as well as that of their colleagues. This report has a wide target audience: politicians, branch representatives, heads of companies, line managers and specialists in nearly all categories of players. All these can actively contribute to reduce waste and thereby help not only to increase profits and to reduce the price to the customer, but also make a contribution to improving the work environment.

The 31 recommendations presented primarily derive from a series of meetings held with groups from different parts of Sweden. Each group consisted of seven or eight people in leading positions among building contractors, consulting firms, materials suppliers and property managers. The groups in Göteborg and Malmö met on six occasions, each approximately three hours long. At the first meeting different types of waste were discussed. The second meeting was devoted to the causes of waste. During the subsequent meetings recommendations were formulated and discussed. The sixth meeting was devoted to exploring how the list of improvements could be further improved. A Stockholm group was more of a reference group and met less often. We have

received some support and examples from Lean continuation courses for the construction sector given by Chalmers School of Continuing and Professional Studies.

In our previous report (first published 2005, English translation published 2007), we proposed adopting the vision of halving production costs, i.e. the cost to the customer, should be halved. The proposal was based on a survey we carried out, and primarily on the finding that direct waste for the sector amounted to approximately half of its total costs or half the lead times of specific activities. Work on the present study has reinforced our belief that it is theoretically possible to halve the sector costs and that it is realistically possible to halve costs and lead times of many sub-processes and tasks. To succeed we need a new way of looking at costs, i.e. at how resources are used. The current recession only re-enforces this need.

We direct warm thanks to all the organisations, networks and individuals that worked with us in this study.

- Research and Development West (FoU-Väst), a committee within The Swedish Construction Federation, initiated the study and supported its implementation (www.bygg.org/fou_vast.asp).
- The Development Fund of the Swedish Construction Industry (SBUF), which

considered the study to be valuable and financed the greater part of the work (www.sbuf.se).

- The Centre for Management of the Built Environment (CMB), a cooperative effort between Chalmers University of Technology and the built environment sector, which took part in the study and partially financed it (www.chalmers.se/cmb).
- The Forum for Building Costs at The National Board of Housing, Building and Planning, whose purpose is to create better and cheaper homes and which showed great interest in the study and provided partial funding (registration number 504-1591/2004).
- Cooperating companies, most importantly FO Peterson & Söner, who managed the project and administered the study.
- All the individuals that have participated in the group discussions, individual interviews that led to the recommendations presented in this study.

Preface to the English version

Since the Swedish version of this report was published in June 2009 we have continued our efforts in increasing our understanding concerning waste reduction in construction. Among other initiatives we have asked a large number of employees how they perceive their firms prioritise the 31 recommendations presented in this report. Top recommendations are often define the customer's true needs (rec. no. 6), stimulate further education for all employees (20) and strive for long-term customer-supplier relation (8). Bottom recommendations are often use all 168 hours during a week (9), support your main suppliers in their development (16) and measure performance in order to discover waste (28).

A special thanks to Vesa Räisänen for the translation of the report.

This work has been carried out within the Sustainable Production Initiative and the Production Area of Advance at Chalmers. The support is gratefully acknowledged.

Göteborg, March 2011

Per-Erik Josephson and
Lasse Björkman (born Saukkoriipi)

Abstract

Those companies and organizations that wish to ensure long-term profitability must successively decrease resource use in both product development and in product usage. Primarily, it is waste that must be reduced, i.e. the consumption of resources that do not add to customer value or to the organization. Waste is widespread in all operations. Even in well-functioning processes, more than half of the resource consumption can be classified as waste. One obstacle to waste elimination is that most waste is hidden. Thus, executives, middle management and specialists must prioritize efforts to uncover the waste in their operations.

Building and construction activities consist of a complex system of decisions, components, organizations and processes that must be coordinated. There are therefore many explanations as to why waste arises, or does not. Based on a series of discussions with experienced builders, consultants, contractors and materials providers, five main groups of factors that characterize effective operations were found. In this report these factors are illustrated in the form of a “value pyramid”. A holistic view of long-term customer benefits is the apex of the pyramid. Structure, competence, leadership and culture act as the driving forces at each corner of the pyramid’s foundation. Should one of the corners give way, then the pyramid risks toppling over.

With the value pyramid as support, 31 recommendations for what should be done to

reduce waste are presented. These are aimed at standardizing the product from an overall perspective (five recommendations), defining and standardizing processes (ten recommendations), developing the organization and its competence (seven recommendations), disciplining management (five recommendations), and driving continuous improvement work (four recommendations). Reducing uncertainties and increasing effective time utilization are the red threads, as the Swedes would say, that run through all the recommendations.

Everyone who uses resources has a responsibility to reduce waste. By systematically monitoring one’s own use of time, one can gain insights that will help improve one’s work situation. However, the burden of initiating and driving improvements overall obviously lies with management. How this should be done depends on the nature and purpose of the activities as well as on the organization’s capabilities. It is to manage this progress and achieve profitability that managers are appointed. It is in the interest of all enterprises and organizations to develop the ability and an interest to detect and understand what work/task is value adding what is not. This ability will provide possibilities to develop new competitive advantages and new business concepts.

Part I

Challenges and Opportunities

1. Big challenges and a higher level of ambition

The desire to cut costs

In Sweden, an intensive debate has been ongoing for a number of years concerning building and production costs. Statistics indicate that the costs for producing buildings have risen sharply in recent years. Figure 1 shows how the building price index with deduction for allowances, and consumer price index, has developed since 1989 for multi-dwelling buildings and collectively built one- or two-dwelling buildings. These statistics have been questioned, partly because more exclusive tenant-owned flats have been built than had previously been the case. The market situation is also important as, during periods of rapid economic growth, costs increase only to decrease again during economic recessions.

Lowering these costs is a high priority for both the building and construction sector and its

companies as can be seen from the following statements made by CEOs of large corporations:

"Lower costs is the prime concern of the construction business"

Mats Williamson, Executive Vice President, the Skanska Group¹

"We have set a tough, challenging and ambitious goal of lowering costs for construction by five percent yearly for the next five years. And this does not mean lowering standards which I see as only delivering less."

Tomas Carlsson, CEO NCC Construction Sverige²

1) www.fiasverige.se Apr. 22, 2008, Williamson was the CEO for Skanska Sweden when he made this statement

2) www.byggindustrin.com, Nov. 28, 2007

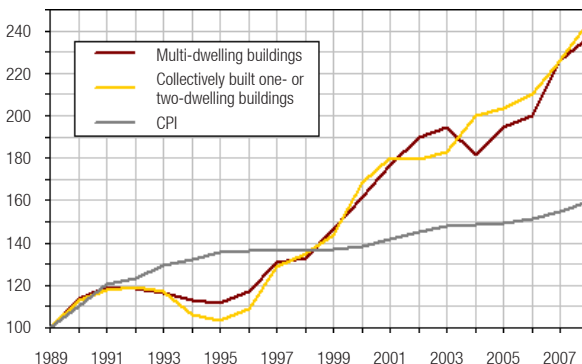


Figure 1 Building price index with deduction for allowances, and consumer price index (CPI) 1989-2008 (Statistics Sweden, Feb 2, 2010). Note that allowances vary greatly between the years, which contribute to variations in the building price index. Index 1989=100.

Reducing costs has become more relevant due to the financial crisis in the autumn of 2008, which led to the current depression and to reduced construction of buildings. Reducing costs in the long-term, however, requires that any given product be produced using less resources.

Companies raise their level of ambition

During the last few years, the Swedish construction and real-estate companies, especially the “Big 3”, Skanska, Peab and NCC, have raised their ambition levels. Skanska Sweden’s vision is to serve as an example not only for the Swedish construction industry, but for Swedish industry as a whole. They intend to decrease their purchasing costs by 25% within the next few years. They have launched “the five zeros vision”, which stands for zero loss-making projects, zero work site accidents, zero environmental incidents, zero ethical breaches, and zero defects.

“We shall be a role model for Swedish industry”

The vision of Skanska Sweden

NCC intends, as stated in the quote on the previous page, to decrease their costs by 5% per year for the next five years. At the inauguration of the NCC Complete factory in Hallsthammar (now being closed) the CEO, Fredrik Anheim, stated that “the factory will be so good that Scania will want to come here to see how we have solved

things”³. Scania is often mentioned as an example of efficient production. A few years ago Peab had a photograph on their home page that showed the owners, the Paulsson brothers, embracing IKEA’s Ingvar Kamprad. There is clear symbolic value to being associated with Kamprad, who is often referred to as one of Europe’s leading managers, and with IKEA, internationally known as one of few real success stories. The large consulting companies also formulated their raised ambitions in similar terms. For example, SWECO’s vision is “to become Europe’s most respected knowledge company in the fields of consulting engineering, environmental technology and architecture”⁴. WSP’s vision is “to be the outstanding supplier of specialist and integrated services in the built and natural environment”⁵. Ramböll Sweden’s goal is to be perceived as the best company on the market by their customers.⁶

These visions, improvement programs, statements and descriptions have various aims, e.g. to guide the co-workers in the ongoing improvement work and to create the image of a progressive company. They also put expectations on the companies and their efforts to develop the organization and to create efficient processes.

3) Dagens Industri, Apr 27, 2006

4) www.sweco.se, May 7, 2010

5) www.wspgroup.com, May 7, 2010

6) www.ramboll.se, May 7, 2010

The big question is how these companies should proceed in order to fulfill their new ambitions. It is easy to set goals but harder to meet them, especially during recessions when priorities are suddenly transformed into short-sighted decisions. In this study we contend that companies and other organizations should lower their costs by actively and systematically decreasing waste, i.e. by eliminating those activities that use resources and do not create any customer value. We recommend that focus should be concentrated on how the available resources are utilized. This strategy can be used irrespective of other strategies and of the market situation. And with increased competition the strategy becomes even more important.

Increasing profitability and competitiveness

To make money is a company's prime goal, but in many sub-sectors profitability is low. During the last five-year period the net-profits of the largest construction companies and of the largest design companies has been around five percent of the turnover. The largest specialist contractors have only reached half of that figure, see Fig. 2.

To make money requires competitiveness. A current trend is that competition from low-cost countries is on the increase due to the global development. For example Baltic and Chinese contractors now operate in Sweden. Swedish companies buy labor construction work from

Eastern Europe and consultancy services from India. Even construction materials are being increasingly purchased from Eastern Europe and China. Swedish companies cannot currently compete with the low wages and low prices for premises, equipment, etc. They must therefore compete by using efficient processes in both production and management.

Another trend is that boundaries between different industries are disappearing. In a few years, this could well lead to a situation where the main competitors will be other industries. In Japan, for example, the largest home builders today were originally companies manufacturing completely different products. IKEA, which fabricates furniture and household items, has cooperated with Skanska for a number of years within BoKlok. Scania manufactures products including roofs, floors, walls, ventilation, electricity, etc. Ericsson? Well, as we all know the need for communication products and systems is developing rapidly.

Other effects of less waste

More efficient processes with less waste give rise to other important benefits for companies as well as for society in general. Reduced environmental impact (the climate problem), reduced workloads and subjective stress (the occupational health problem), and in increased attractiveness (the recruiting problem) to mention some examples.

	Net margin (% of turnover)				Turnover (Mkr)	
	2007	2006	2005	2004	2003	Average (2003-07)
Construction companies						
JM AB	18,2	5,3	15,4	0,1	12,6	7,336
NCC AB	11,5	2,3	6,0	5,2	-0,7	18,286
Peab Sweden AB	4,2	2,3	1,2	1,4	1,1	16,307
Skanska Sweden AB	1,9	3,3	5,8	4,5	2,0	20,766
Design companies						
Ramböll Sweden AB	8,7	7,2	6,8	6,6	3,4	766
SWECO AB	9,3	9,4	10,4	6,5	5,4	3,438
White arkitekter AB	8,8	9,8	-3,4	0,3	-4,4	285
WSP Sweden AB	5,2	5,1	5,4	3,0	2,4	1,664
Specialist contractors (installation)						
Bravida Sweden AB	6,4	3,0	2,0	1,8	1,8	3,623
NVS Installation AB	6,4	3,9	1,6	0,4	-0,6	1,946
YIT Sweden AB	5,6	3,7	2,0	2,3	3,2	3,978

Fig. 2: Net profit margin of major Swedish contractors, designers and specialist contractors (Source: Bolagsinfo).

Less environmental impact (the climate problem).

Recent reports from the UN have concluded that the climate problem is in fact a real problem, and in all likelihood produced by humans. Due to the nature of the activities and products, the construction and real estate sectors are responsible for a sizable portion of the total environmental impact, and thus have a large responsibility in reducing their environmental impact. The Stern (2006) report presents a comprehensive analysis of the economic consequences of climate change. It states that buildings contribute eight percent of the world's total emissions of greenhouse gases. If the emissions from heating and electrical power are included this share increases to 20%. IPCC (Intergovernmental Panel on Climate Change) – it received the 2007 Nobel peace prize in recognition of its research on climate change – has collated data from several studies and concludes that energy use in buildings is responsible for 33% of all greenhouse gases produced by humans (IPCC, 2007).

For Sweden the figures are 39% of the energy consumption and 44% of the materials use. If we continue like this, carbon dioxide emissions from buildings are expected to rise by 70% between 2003 and 2030, and by 140% by 2050. However, the potential for effective measures is larger than for many other areas. Many measures can be implemented that have low, or even negative, costs as many investments in energy efficiency make costly investments in additional capacity

unnecessary (Stern, 2006). It is also self-evident that more efficient processes with less waste entail less resources being consumed.

Reduced workload and subjective stress (the occupational health problem). Many Swedish construction workers suffer from burn out or exhaustion and are forced into early retirement. Only 40% of the construction workers work until the age of 65. The work environment of office workers has also become more stressful. Sick leave and early retirements put significant strain on the national economy (increasing the need for higher taxes) as well as on project budgets. This is an untenable situation. In 2001 a study revealed that 71% of all construction workers over 50 had permanent injuries that affected their daily lives. Also, 78% of the construction workers felt their work was stressful and hectic (Byggnads, 2002).

Musculoskeletal disorders are the most common type of occupational disease in skilled workers in the building and construction sectors and cause 73% of early retirements. 5.8 out of 1000 skilled workers (642 in all) are forced into early retirement each year. However, it is probable that the “healthy-worker effect” causes many people who find their jobs strenuous to leave the industry for other occupations at an early stage (Samuelson, 2004). A quarter of those who left the building and construction sector did so mainly because of the work environment (Samuelson & Andersson, 2002). In 2006, the share of accidents reported to the social

insurance office (Försäkringskassan) for skilled and office workers was 12.5 out of 1000 cases. For those employed in the private building and construction industries, the corresponding figure was 13.6 out of 1000 (Samuelson & Lundholm, 2007). Serious occupational injuries (resulting in more than 30 days sick-leave and/or medical disability) affected 12.5 out of 1000 employees in 2005, and of these 56 % were medically disabled. The corresponding figure for all occupational groups was 5.1 out of 1000 (Forsblom et al, 2007). During 1995-2006, an average of 11 fatalities due to accidents related to construction activities occurred (excluding travel to/from construction sites) (Samuelson & Lundholm, 2007). During 2007 and 2008 fatalities have further increased (Byggnadsarbetaren, 2008). Activities with less waste entail fewer operations with unreasonable physical and mental loads. Activities with less waste also entail that flaws in the work environment as well as risky practices become visible.

Increased attractiveness (the recruitment problem). Companies in the built environment sector are nearing a critical generation change. Many large and medium-sized companies have uneven age distributions and an alarmingly high average work force age. The companies' (and the sector's) ability to attract younger people is often cited as one of the most important problems that have to be solved. Certain behavior in the built environment sector has given its companies a

questionable reputation. Instances of negative publicity for the construction sector have been common during the last few years. The national committee for building notes (SOU 2002:115) that in several parts of the market there is insufficient competition, e.g. in the manufacture of concrete, cement, asphalt, plasterboards and insulating material (Ericsson, et al., 2002). About a third of the cartels that have been investigated by the Swedish Competition Authority are in the construction sector (Ericsson, et al., 2002). The largest antitrust case in Swedish history involved the so-called asphalt cartel. Nine companies were fined 1.2 billion SEK for defrauding the state and municipalities by having divided the market between themselves and for having rigged the bidding process (Konkurrensverket, 2007). Another problem is tax evasion by using illicit labor, usually by third and fourth tier sub-contractors. The Swedish Tax Agency (2002) estimates that undeclared wages in the construction industry amount to 2.5-3 billion SEK yearly. Corruption and bribes are also common. Moreover, companies that systematically employ illicit labor are often involved in other types of crime: harassment, threats and physical violence (Carlström et al., 2007). SP Technical Research Institute of Sweden found that 95% of all houses with plastered facades built in the last decade are susceptible to moisture damage and mildew. Nearly all of 500 examined houses were to some degree damaged by moisture (Samuelsson, et al. 2007). Examples

of moisture damage reported in the media in recent years are the newly built Moderna Museet in Stockholm (a museum of modern art) and houses in Hammarby Sjöstad in the Stockholm area, which had moisture damage even prior to completion. The scandal of the water leakage and the poisonous sealing compound Rhoca-Gil during the building of the tunnel through Hallandsås in the Western region of Sweden is still fresh in the minds of many people. For this, Skanska and the former Railway Authority were in 2001 sentenced to pay 3 and 1.5 billion SEK respectively in fines (Mårald, 2007). In addition, there are many other situations that influence the public's perception of the construction: projects that go over budget and are delayed, e.g. the Turning Torso in Malmö, large infrastructure projects and arena projects, as well as suspicious situations such as puzzling cost escalations. More efficient processes and less waste do not automatically mean that the aberrations disappear, but they can compensate for them as well as show that the sector is modern, professional and attractive.

2. Waste reduction generates much optimism

The concepts cost and waste

Cost can be defined as the value of a resource sacrifice. This means that a project organization that aims to reduce costs has two alternatives. One alternative is to use resources that are valued lower, e.g. buying building materials at lower prices, or using a workforce with lower hourly costs. Another alternative is to develop ways of working that enable the production of the same product using less resources, e.g. by work methods that require less man-hours. The first alternative yields only short-term effects as prices are short-lived and can quickly change. The second alternative leads to long-term benefits as the organization dictates its own work methods and can use the same methods in several projects.

Let us examine a current example, namely Swedish construction companies purchasing building materials from low-cost countries. Suppose that the manufacturing process in the low-cost country is currently as efficient as it is in a factory in Sweden. This would imply that the same number of resources is used in both countries. The difference lies in that the resources are less expensive in the low-cost country, i.e. that per unit resource is cheaper in the low-cost country. However, the consumption of resources due to transportation from the manufacturing site to the construction site is greater than in the first case.

The difficulty lies in balancing short-term price consciousness and long-term resource consciousness. We make a case for resource consciousness. The main reason for this is that lower-resource alternatives have a greater potential to lower prices later on and thus increase competitiveness.

The term waste is regularly used in everyday life as well as in industry and in academia, but the meanings differ. Our definition of waste is “any activity which absorbs resources, but creates no value”, which is in line with Womack and Jones (1996). The starting point is the customer and the costs the customer is charged. This means that we, when we consider waste in construction projects, start with the customer’s wallet and from there try to follow the money flow. As soon we find some “customer money” being used on something that does not create customer value, we have uncovered waste, irrespective of whether this resource use is within or outside the project organization.

It is often difficult to draw a clear line between what is waste and what is not; the grey zone can be extensive. Should support and management processes, which only contribute indirectly, be classed as waste? For this reason we differentiate between preparations and waste. By preparations we mean processes that are necessary for the value-adding work to be carried out. By waste we mean processes that lack a connection to the value-adding work. The idea is that improvement

initiatives primarily should focus on reducing waste and secondarily on trying to make preparations more efficient. Development efforts often focus on changing the value adding work. The potential is, however, many times larger by trying to reduce waste.

What is considered as value adding and what as waste depends a lot from whose perspective the activity is viewed. A researcher will say that writing a scientific article is value-adding work. In much the same way a designer's production of technical drawings could be considered value adding. However, the customer is the one who will use the product, e.g. live or work in a building, and will therefore only consider activities on the construction site as value adding. For the customer the design work is preparation.

There are many related concepts, e.g. defects and deviations, that should not be confused with waste. Defects and deviations are in themselves not waste unless they lead to correctional measures. When they do result in corrective actions then they are considered waste since additional resources are consumed. Inefficient processes also contain waste. Waste can therefore be seen as a broader concept.

The real cost structure – do not forget the suppliers!

It is vital for managers to understand the real cost structure and, above all, the real cash flows.

Consider for example the building companies that say they buy materials and services for 70-80% of their turnover. This then means that the greater part of the “customer’s money” flows straight through the company’s cash box to the suppliers. This also means that the building company is responsible to the customer for the supplier’s work, but also has a large opportunity to work alongside the supplier to streamline processes. This example is even clearer when applied to the client. This line of reasoning makes it clear that it is preferable for the company to prioritize long-term cooperation with a limited number of suppliers rather than to press prices by repeatedly playing potential suppliers against each other.

From the point of view of the sector or of society as a whole a wider perspective is necessary: we need to consider processes that are financed using tax revenues. The tax burden on construction is about 50% of the total production cost including taxes on materials, work, etc. The state, county councils and municipalities bear the responsibility to streamline their processes in order to reduce the tax burden. However, even the built environment sector (including the state, county council and municipal companies and organizations) can influence the tax burden. Less work related injuries and illnesses imply less need for health care, rehabilitation and early retirement.

So, how can companies help their suppliers to reduce waste? And what can the companies do to reduce the need for municipalities to levy tax?

To monitor all the processes financed by money that flows through their own cash boxes should be self-evident for all companies seeking to become world-beaters.

How much waste is there?

As mentioned earlier, many practitioners, e.g. designers or site managers, feel that everything they do is necessary to create the buildings and constructions they work on. For these people waste accounts for maybe a couple of percent of their work time. Using another perspective one can say that value is added to the product only when a screw is driven to secure a plasterboard and so waste seems to be more than 99%! In our earlier mapping of waste, published in a report in November 2005, we showed that waste makes up at least 30-35% of construction project costs. It is interesting to note that no matter which activity or resource was studied, half of the costs and half of the time consumed was waste. Most of this waste is hidden from the players in the sector, mainly because they are not used to assessing which activities add customer value and which do not. For practical reasons waste had been organized into four main groups:

- *Defects and checks.* Costs of visible and hidden defects, inspections, insurance, theft and vandalism account for approximately 10% of the project's costs.
- *Resource use.* Costs due to inefficiency, waiting, inactive machinery and wasted material amounts to approximately 10% of the project's costs.
- *Health and safety.* Costs related to work injuries and illnesses, e.g. rehabilitation and early retirement amount to approximately 10% of a project's costs.
- *System and structures.* In the 2005 report examples of this type of waste are extended detail level planning, extensive procurement processes and documentation which together account for approximately 5% of total project costs. This group was, however, the one that was most underestimated in the study.

In addition to this waste, we know that we were not able to identify many sources of waste. It is therefore reasonable for the sector to adopt a common vision of halving production costs in the long-term.

We also stated in the report that practitioners in general don't know the extent of the total waste. They don't have the ability to see which activities that are value adding and which are not. We also found that the construction sector as a whole lacks customer focus, at least if we look at how the companies use the customer's money. We also noted a tendency for improvement work to increase administration resources, this resulting

in more waste while the basic problem remained unsolved. We also stated that the structure of the construction sector hinders process-oriented thinking and that the players in the sector tend to increase the size of their own hunting ground rather than jointly developing more efficient processes. All actors should therefore place increasing focus on the important process, not just talk about doing so.

The mental maneuvering space

It is often said that the construction sector are conservative and unwilling to change. This unwillingness has also been mentioned as one reason for much of the waste in the sector. Yet, at the same time, many of the employees enjoy a

broad space for “mental maneuver”. A concrete example of this is when we posed the question “How much do you think production costs can be lowered over the next ten years without lowering quality?” to 457 people from diverse groups of players, with a preponderance of contractors interested in progress. We have asked this question at the beginning of industrial seminars, continuation courses, and in-house sessions, on some occasions we included university students. Three quarters (75%) of those questioned believed the reduction potential to be 10-30% (see Fig. 3). When a person has accepted the possibility of reducing costs he/she has also created the mental maneuvering space that allows for the realization of reductions. Someone who does not see that there is a possibility of saving will probably not

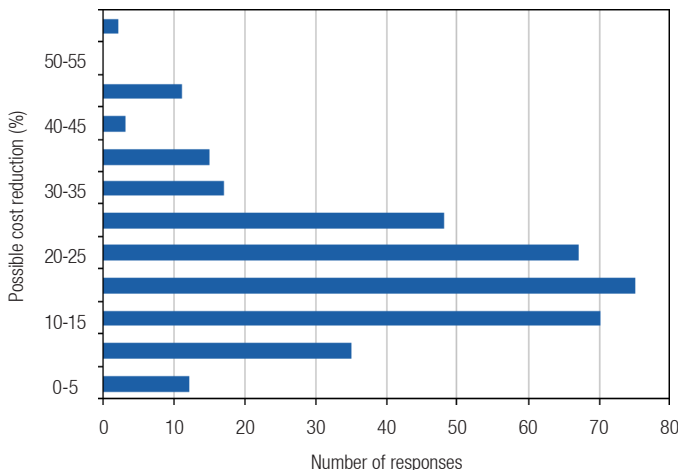


Fig. 3: “How much do you think production costs can be lowered over the next ten years without lowering quality?” The question was answered by 457 people from diverse groups of players.

be able to make the necessary changes as his/her thoughts are to a great extent locked into the problem of not raising production costs. It is thus important that all managers have regular discussions with the workforce on how work and activities are carried out and what adds customer value in order to create the required maneuvering space.

Probably all the sector's employees have mental maneuvering spaces of around 15%. Should the sector set this as a common goal then approximately SEK 40 billion could be saved yearly. This improvement will also make the processes clearer and more areas for improvement will be discovered and new goals can be set up for the next period. But it is still essential to identify the direction, i.e. to reduce waste, and to work in that direction rather than setting concrete goals.

3. Large risks and uncertainties

A complex system that causes waste

All work done by managers and other leaders, irrespective of their organizational position, is aimed at effectively fulfilling customer expectations. All decisions are made with the purpose of minimizing waste. The purpose of customer meetings is to clarify goals and to increase understanding of customer needs. The purpose of staffing is to create a competent organization with all the required skills. The aim of planning and steering is to use resources in the most efficient way to reach the goal. Follow-up is used to identify deviations and to guide corrective measures in both ongoing and future projects. So why is there waste? Is it due to lack of knowledge? Is competition too weak? Could it be that short-sightedness really is profitable?

To get a clearer picture of why there is waste in construction we formed discussion groups consisting of a number of experienced people. First we asked them to individually list the main instances of waste in their own operations. These examples were then used to discuss the likely root causes of each instance of waste. The list of root causes was long, but it was discovered that in most instances there were one or more additional causes for the waste. So, waste has a complex system of causes. To get an overview, the causes for waste were successively sorted into fewer

and fewer groups. Over time five main groups crystallized, which we chose to call holistic view, structure, culture, competence, and leadership.

Holistic view. By an inadequate overall view we mean partly the inability to understand the purpose of all activities carried out and partly to understand how the different sub-processes in a project are linked together. It also implies an inability to identify what is of optimal benefit to the customer, to the product, and to all contributing actors. Examples of inadequate holistic assessments are that companies sub-optimize, that companies focus on short-term profits, that companies overlook hidden costs, and that companies fail to analyze total costs.

Structure. To carry out a building or construction projects action is required from specialists in many authorities and companies. The project organization and procedures are therefore very fragmented. This places demands on planning, co-ordination, procurement, and the management of resources at all stages of the project. Many specialists are supported by their own branch organizations. A guild mentality has developed in which the guild has priority over the customer value-adding process. Materials and techniques must be coordinated so that the required result is achieved. By inadequate structure we mean disorder and confusion at all system levels. Examples of inadequate structure are unsynchronized technical systems, diffuse boundaries between areas of responsibility, faulty

communication structures, unclear incentive structures for pay scales and promotions, as well as questionable procurement practices, ways of measuring piecework and inadequate work method preparation.

Culture. By culture we mean a set of attitudes and values shared by a group of people, leading to certain behavior within the group, e.g. within the company, the fraternity, or the sector. An inappropriate culture can consequently have devastating results for the group but, even worse, for the customers. Frequently conservatism, aversion to organizational changes, and an unwillingness to learn are cited as examples of unsuitable cultures. Inappropriate culture also encompasses lack of a sense of responsibility, lack of commitment, conflict between occupational groups, lack of pride, as well as questionable views on ethics, morals, health, safety and environmental issues.

Competence. By competence we mean the ability of organizations and individuals to both carry out their tasks and also to understand how value can be passed on to the end customer. Lack of competence includes all the deficiencies that are a result of a lack of the appropriate skills and knowledge in the organization. It can also mean a lack of information and training as well as a lack of understanding of the value of the resources.

Leadership. By leadership we mean how executives and project managers influence the group's

attitudes and values. Leadership thus has a large influence on group culture. Inadequate leadership can mean that the leader is weak, i.e. his influence on the group's attitudes and values is slight.

Inadequate leadership can also be that the leader generates questionable or erroneous attitudes and values in the group. It is quite common that leaders stress the importance of a certain value, but do not themselves act in line with this value.

As pointed out earlier, the causes of waste are weaved into a complex system. The relationship of the five main groups of causes of waste can be illustrated in the form of a pyramid, see Fig. 4.

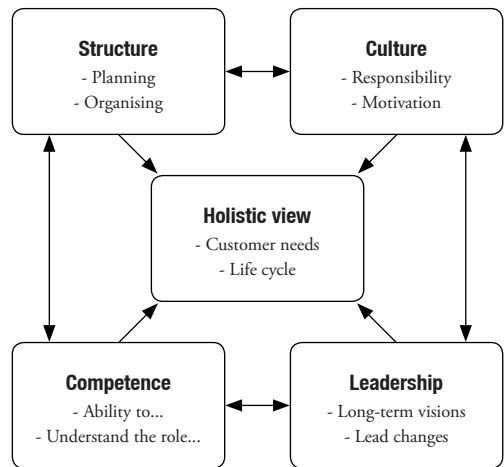


Figure 4: The value pyramid. Long-term profitability depicted as a pyramid with the overall view at the top and structure, competence, culture and leadership at the base.

The overall view is at the top of the pyramid since long-term customer value is the decisive factor. Structure, culture, competence and leadership are the sources of the overall view and as such constitute the foundation of the pyramid. The stronger the foundation, the steadier the pyramid. We will call it the value pyramid as this is about the channeling of all efforts into creating customer value.

Large uncertainties create significant resource consumption

The sector, the companies and the individuals seem to have a tendency to always – often intentionally - “build in” uncertainties into the products, processes and organizations. We saw this in the previous chapter. For example, companies and people actively choose to:

- create unique solutions and “unique” products
- ambiguously describe customer demands and project goals
- work with large time and product configuration tolerances
- only make rough project and activity plans
- create new organizations and work with previously unknown
- seldom use experiences from earlier projects

- expose oneself to weather effects

The companies and their employees have thus created a tradition of working with large risks and uncertainties. The results of this attitude to risk are unanticipated surprises (often negative), variations in processes and in the outcome. Think about the following excerpt from a conversation we overheard during a train journey: in the seat in front a man was speaking loudly into his cell phone obviously trying to solve some problem concerning some ongoing building project.

– “No, but then I’ll have to order tiles. I don’t know what delivery times they have...”

–

– No but you misunderstand me. You’re supposed to measure the length times the width

–

– No, listen! You’ll have to remove the panel...

–

– Did you talk to the electrician? They say there’s a mistake and they cannot continue. We have to remove the panel. Could you check if it is possible or whether we’ll have to do it in some other way...”

We are all familiar with this situation. Problems materialize and the person in charge has to solve the problem so that work can continue. The effect of the disruptions is that many resources are consumed unnecessarily, i.e. with no resulting

customer value. But why are there so many negative surprises in projects?

It may be so that a majority of the people, especially those working in projects, is trained to work under extreme risks and uncertainties and therefore only feel secure in an environment with daily surprises. Their strength lies in solving acute problems and the rewards are self-esteem and the respect of their colleagues and managers after each problem is solved.

It is therefore crucial for organizations wishing to reduce waste to gradually change attitudes and behaviors in their organization. Whether it is in a client organization, a design company, contractor, materials manufacturer, or any other organization, the new hero must be the one whose activities produce no negative surprises. It is only then that planning and organizing will render the desired result, and it is only then that customer requirements may be fully met.

Building and construction projects often at a standstill

Short and rushed planning and construction times, speed and excitement, hustle and bustle at the construction site, stressed out employees. Yes, this is how construction projects are described. But how accurate is this picture? Suppose we are at a construction site and take a photograph every hour round the clock throughout the year. What is the most common picture we have taken?

About 75% of the pictures will show a vacant and idle building site.

This same lack of activity characterizes most of the resources and processes within the built environment sector. Let us exemplify with a land use planning process. Appeals that delay the start of building projects are frequently discussed. If we follow the appeals process concerning a land use plan and take a photograph every minute throughout the process, what is the most common image? More than 99% of the pictures would probably show the papers lying on a table (or two?) waiting to be processed. Here we then have a considerable amount of idle time that can be used.

An explanation for the first example is that work is primarily planned for the human being resources. As people need time to rest and recover their working time is limited to eight hours a day, five days a week, 46-48 weeks a year, i.e. roughly 21% of the time. Losses are generated when project management allows the other resources to rest concurrently. Inanimate objects such as machines and property do not, of course, need to rest. Questionable priorities are the explanation for the second example.

Obviously a lot has to do with tradition. We have become used to certain ways of dealing with planning and priorities. However, building and construction projects are capital intensive and the interest keeps amounting. Investments in building

and construction projects are made when there is a need. The need remains unfulfilled till the building or structure is completed. There are thus obvious reasons for utilizing more of the time.

Thirty one recommendations for increased profitability

Building and civil-engineering projects are risk and uncertainty prone to a large extent primarily due to active and conscious choices made by project members. The projects are moreover inactive most of the time. This results in unnecessary expenditure of resources, i.e. waste. In order to achieve real and permanent cost reductions the expenditure of resources must be reduced. This should be done by reducing risks and uncertainties wherever possible and by using as much as possible of the available time. Success in working to these principles depends on the attitudes and values of both management and employees.

Based on a series of discussions with experienced practitioners, we have formulated 31 recommendations to reduce waste and to increase customer value. Certain criteria were used, e.g. it was suggested that the measures to be taken should be concrete and clear; measurable, and generically applicable, so they could be adapted to particular situations; and personal (so that it is clear what each person can do). The recommendations were sorted into five groups.

Standardize the product from an overall perspective

1. Base product definition on running costs
2. Prioritize sustainability in system choices
3. Develop technical solutions that can be used for several products
4. Reduce the range of components
5. Standardize components

Define and standardize the process

6. Define the factual customer requirements
7. Oversee that all project members know and understand the project goals
8. Seek long-term customer-supplier relationships
9. Use all of the week's 168 hours
10. Develop similar ways of working
11. Standardize information management tools
12. Plan accurately and follow-up continuously
13. Minimize weather dependency by means of pre-fabricating and weather protected assembly
14. Establish disciplined information structures and meetings
15. Structure supply flows for efficient assembly

Develop the organization and its capabilities

16. Actively support suppliers in their development
17. Select employees with the appropriate skills and attitudes
18. Strive for aligned teams and project organizations
19. Consider new skills to meet new approaches
20. Encourage further training
21. Support the development of individual effectiveness
22. Plan in reflection and training

Discipline management

23. Base management decisions on a long-term philosophy
24. Strive for order and neatness in the workplace
25. Give clear instructions, which cannot be misinterpreted
26. Set high standards that drive development
27. Reward good work

Carry through successive improvements

28. Measure in order to uncover waste
29. Measure to control improvement work
30. Collect and use best practices systematically
31. Link all improvement initiatives to product characteristics or to the value-adding process

Part II

Recommendations for increased profitability

4. Standardize products and processes

Our lives are highly standardized. For example, we drive on the right hand side of the road so that the traffic will flow effectively and to reduce the risk of accidents. Also the products we use are highly standardized. Our local newspaper has the same layout every day so that we will be able to quickly find what we want to read. The purpose of standardization is of course to make our lives easier, i.e. more convenient and less uncertain.

Even the building industry and its products are standardized in many respects. Products cannot have just any appearance nor can they be placed just anywhere. Processes are very similar irrespective of the company involved. Roles are also very similar in most projects. However, in comparison with other industries, e.g. the automotive industry, there is a lot leeway in how components, products and especially processes may be formed. This freedom naturally has positive aspects, but at the same time it entails large risks.

The individuals working in construction value the extensive freedom, but at the same time they express frustration over the many problems that arise. To reduce waste, it is thus extremely important to gradually standardize both products and processes in such a way that risks and frustrations are minimized without constraining the sense of freedom of those concerned. Further, standardizing should be done without affecting the product, i.e. a building's appearance.

Standardize the product whilst taking into account its life cycle

This section covers the recommendations that aim at standardizing and simplifying the handling of components as well as the use of the completed product. By choosing appropriate components and technical solutions, risks and uncertainties in the process can be reduced as can running costs. With a smaller range of well-tested components administration, working hours, inventory costs, and tolerances can be reduced.

- Base product definition on running costs (1)
- Prioritize sustainability in system choices (2)
- Develop technical solutions that can be used for several products (3)
- Reduce the range of components (4)
- Standardize components (5)

Base product definition on running costs (1)

Products are usually planned and defined based on a short-term perspective. The project budget is fixed early on and covers the period up to completion. This entails that the budget limit governs every single decision.

When a project is initiated, all the decisions and all efforts are focused on not exceeding the determined investment cost. A project is considered successful if the investment cost is not exceeded. During the planning phase and indeed

during the whole program, situations occur in which new solutions are proposed. In every such situation the organization has to check whether the new solution is within the budget. If e.g. an installation consultant proposes a solution that will cut energy costs, it will be rejected unless it is within the budget.

To reduce waste and to increase long-term customer value, it is instead recommended to take into account costs that are likely to materialize during the product's life cycle. An office building can, for example, fix a maximum cost comprising running, maintenance and investment costs. This approach leads to considerably more long-term decisions. Long-term analyses are currently carried out on individual machines, e.g. coolers, but seldom on a whole building or plant. An installation consultant provided the following example: "When we were building for the university we set very tough energy use goals. A quick calculation that took into account the number of students and computers as well as cost of cooling the premises showed that we would be able to reduce insulation by five cm, which of course made everyone happy. Existing models or more advanced tools for long-term analysis should be used as decision-making supports.

Prioritize sustainability in system choices (2)

The products produced by the construction sectors are becoming increasingly complex. Especially the volume of installations for

electricity, water, drainage, heating, cooling and communication is increasing rapidly. The customers' needs for technical systems are changing continuously as is the need for flexibility. Technical progress moves at a rapid pace.

In step with increases in product complexity, the need for specialists with insight into particular details is growing. Organizations and processes tend thus to become evermore fragmented.

To reduce risks during construction and building use the systems, the choice of appropriate procedures should be prioritized. This will create a clear structure for the planning and production processes as well as for their use.

Develop technical solutions that can be used for several products (3)

There is a tendency to think that every new project is unique and so the organization will seek to create new, untried technical solutions. This can lead to creativity and innovative solutions, but also to inefficiency and high risks of delays as well as other types of waste.

Many suppliers have modular systems, e.g. manufacturers of prefabricated concrete elements. A materials manufacturer explains: "But the customers do not want this because of the associations to the '70s when they constructed square buildings. They will not even accept modular dimensions in some parts of the house,

which will change that which should be unique. The surface layer has to be unique even if the shell is modular. An installation consultant added: “You can get very far if you use standard solutions without changing that which is unique to an apartment. ... Many architects are very good and realize this whilst others do not”.

In order to reduce waste, standard solutions and modular design should be used more extensively. A project manager supplied the following example concerning office space: “The size of the offices is suited to the window size and to the wiring. This makes it easy to change as well as to debit since the sizes are known in advance and fixed. A customer described the contractor instructions they had compiled as: “... a common standard and an account that will ensure a good quality level at the least possible cost to the customer. By standardizing the most common types of constructions we hope to achieve lower planning and installation costs, less errors and greater usability. This means that even the fitters and designers of our contractor and consulting firms must be familiar with these instructions. The result will be an easier work flow with fewer questions on issues addressed in the standard.”

Major construction companies develop technology platforms, i.e. technical solutions that may be used in several product groups. As stated earlier, many materials manufacturers have developed standard solutions for different needs.

Reduce the range of components (4)

An enormous number of components intended for construction are available in the market place. Individual projects tend to use two or more components of the same kind. This leads to complicated and risky processes. A contractor mentioned his frustration over the often, large numbers of components: “We have had contracts for producing buildings with 41 different types of doors. This must be some thought of optimizing the building somehow behind this decision. Each individual door was optimized, but how they think it all should be administered at the construction site I don’t understand.”

This recommendation is aimed at reducing the number of similar components in projects. Naturally there has to be room to adapt the product according to a customer’s wishes, but in many cases neither function nor appearance is affected. A materials manufacturer said: “Previously we used most of the available existing dimensions of wiring conduits when embedding cable conduits. This entailed that many different articles had to be stored, e.g. 16 mm Vp-conduits, 16 mm Vp-tubing, 20 mm Vp-conduits, 20 mm Vp-tubing as well as the matching sockets for each dimension. Now we have agreed to use only one dimension of these pipes. Even if 16 mm is prescribed we use 20 mm Vp-conduits. This has resulted in less variation and fewer articles in stock. This also eliminates any possibility of confusion over sizes on site.”

Thus the positive consequences of a smaller assortment of components are reduced costs for handling, administration and storage, as well as the reduced risk of errors.

Standardize components (5)

Today's rapid, global progress increases the need to standardize components and their functions. In everyday life we become frustrated that every vacuum cleaner type requires its own type of dust bag; each camera has a proprietary battery; or we need adapters to connect our computers and phone chargers to electrical outlets when we travel abroad. The same frustration arises during development and production phases as well as during use when e.g. a component needs to be replaced. A contractor said: "A common problem at construction sites is that today the interfaces between different building elements are not standardized. The industry has adopted standards for constructing interior walls, for laying roofing sheets, etc. What is often lacking are standard solutions to connect the different building elements together, e.g. to join a glass front to a brick wall or window sheets around windows. Architects take great pains to draft these connections for each specific project. Yet these solutions do not work sometimes, and they have to be re-drawn or re-thought on-site."

More standardized components reduce the risk of faults during all phases. A materials manufacturer provided this example: "Earlier we had different

edge sizes on small circular products. The difference between two article groups could be as little as two mm, how should they then be joined ... , so we had to remember all these sizes, and if we made a mistake the product could not be used as was thought. Now we use a standard 10 mm dimension for all these products."

If there were more standardized components there would be more opportunities to develop standard solutions for assembling the components. This would result in e.g. less work in the design phase and less time spent (re)solving problems during the production phase. The standardizing of components is a task for companies, businesses and for national and international authorities.

Define and standardize the process

The major construction and design companies each run, depending on what is meant by project, 1,000-3,000 projects yearly. Medium-size construction and design companies each run hundreds of projects. Based on best practice examples, there are huge possibilities for these companies to develop efficient, and common, ways of working to prepare, carry out and follow up projects, as well as for successively further developing ways of working.

The ten recommendations in this section deal with increasing process efficiency. This should primarily be accomplished by structuring information and resource flows and by a greater

use of available time. A suitable level of ambition is that the risk of negative surprises is reduced to a minimum.

- Define the factual customer requirements (6)
- Oversee that all project members know and understand the project goals (7)
- Seek long-term customer-supplier relationships (8)
- Use all of the week's 168 hours (9)
- Develop similar ways of working (10)
- Standardize information management tools (11)
- Plan accurately and follow-up continuously (12)
- Minimize weather dependencies by means of pre-fabrication and weather protected assembly (13)
- Establish disciplined information structures and meetings (14)
- Structure supply flows for efficient assembly (15)

Define the factual customer requirements (6)

A construction project usually entails a substantial investment. A prerequisite for satisfied customers is that they obtain what they have ordered. The

project has to meet specific goals so that the product will support user operations to the fullest. However, the perception that project goals are inadequately defined is fairly common. This often leads to late changes and costly re-work, which in turn complicates subsequent work and leads to re-planning.

The companies that fail to take full account of the factual customer requirements will accumulate considerable waste as they consume resources that will not increase customer value, which is the very definition of waste. It is therefore vital to prioritize and structure the work of identifying both implicit and tacit requirements and to transform these into specific and exact project goals.

An underrated possibility is to graphically represent the product, i.e. to create a three-dimensional computer model that the customer and other decision-makers can virtually walk around in and check how the product fits in the surroundings. In this way one can elicit early feedback on how well the product meets customer requirements. The cost of designing and using these computer-generated models is surprisingly low.

Oversee that all project members know and understand the project goals (7)

Many different kinds of specialists are involved in many construction projects. Their goals are usually representing those of the company

rather than those of the particular projects. An explanation for this is that a majority of specialists are only involved in the project for a limited time, and they seldom meet other key actors. They are therefore not usually familiar with the project goals. A contractor explained: “We lack a common goal for the project, one that everyone can agree on and which is communicated to everyone. And by everyone I mean everybody working in the project including sub-contractors and other suppliers”. Making all those concerned understand the goals is a prerequisite for pooling together which then minimizes the risk of wasting resources on something that does not increase customer satisfaction.

Ignorance of the common project goal contributes to sub-optimization and a lack of responsibility. Therefore all project members should be informed as well as reminded of the overall and the intermediate goals. The project manager should oversee that all the project members involved have understood the goals. An appreciated activity that has proven effective is to have the client, the architect and perhaps also the project planner call a joint meeting to inform all involved parties of the planned operations, of how the product is meant to support the operations, of the specific project goals, and of the critical stages in the project.

An interesting suggestion is to post names and photographs of e.g. the family that has bought the apartment being built or the people who will

work in the office being renovated. This creates a closeness to the customer, which would facilitate understanding and remembering the goals.

Seek long-term customer-supplier relationships (8)

The largest companies have thousands of different suppliers. Traditionally these are procured based on price rather than on performance. This contributes significantly to confused project structures and short-sighted thinking, i.e. each company tries to generate maximal profits in their particular activity. It also gives rise to unstructured projects where a lot of time must be invested in communicating project goals.

In our previous report (Josephson & Saukkoriipi, 2005) we provided an example of the procurement process in a municipal housing project. Over 500 (!) companies that took part in the bidding process were identified. Many projects thus had large, covert organizational structures whose work needs to be replaced in subsequent projects. The resulting time loss in our example was a few months.

The waste is obvious: as obvious as the opportunities to develop a common and efficient process become when two companies try to understand each other's assumptions and competences. The combined expenditure of resources will be smaller and the time used shorter, the risk of errors smaller, and perhaps the most important of all is that cooperation would

enable the continued development of the joint process.

Many companies, especially construction firms, argue that the best results are reached when they can fulfill their orders on trust, e.g. by partnering. This seems business related as they consider it best in a project to choose their own suppliers based on the lowest price. A contractor said: “In the bidding phase we are often quoted several prices for the same elements and a lot of time is spent sending out requests. If we instead had partnering agreements with various subcontractors there would have been no need to send out so many requests. The security provided by such an agreement would have facilitated us jointly finding a competitive bid. This method is to some extent used between us and our customers, but not between us and our sub-contractors.”

For close, long-term relationships, companies should therefore use the same methods to select customers and subcontractors. To sum up, this recommendation deals with reducing the number of suppliers, developing long-term relationships as well as simplifying the bidding process.

Use all of the week's 168 hours (9)

Every construction project involves a large investment for the customer. Capital is inseparable from the product, especially during the production phase. The customer's need for the product generally exists already when the decision to invest in it is made. There are therefore

pressing reasons to get the product completed as quickly as possible. How is it in real life? When development and production run smoothly, work is done during five eight-hour periods weekly, i.e. 40 hours a week. To become competitive and reduce waste every business executive and project manager should assess all activities to establish which ones could be conducted outside traditional business hours.

During some critical projects, such as the rebuilding of heavily trafficked road tunnels or construction related responses to disasters, work goes on outside of normal working hours or even round the clock to minimize disturbances. Design companies purchase routine services from companies in India and Argentina in order to reduce costs. But why not make use of the time differences and design around the clock? Contractors occasionally deliver materials to building sites after working hours. Heavy equipment is expensive to run so why not make use of them during more hours, at least in those areas where no neighbors will be disturbed? In the later phases of production workers complain about congestion on site. Perhaps it would suit one of the teams to shift their working hours to the evening?

This recommendation concerns using as much as possible of the time available. Other industries provide many examples that can be reflected upon. The airline industry tries to maximize the time their aircrafts are in the air as it is then that

customer value is created. In the same way taxi companies try to maximize the time their cars are on the road. So how should construction projects be organized and planned so that value will be added to the product during a greater proportion of time?

Develop similar ways of working (10)

Traditionally every project manager, irrespective of whether he/she is a client, a designer or a contractor, has a lot of freedom to choose, plan, execute and follow-up his/her projects. This sense of freedom is valuable in Swedish culture and greatly valued by project managers. At the same time there is a lot of frustration over the unanticipated incidents that occur daily. Determining what to standardize in order to reduce this frustration, and what not to standardize to maintain the sense of freedom is a challenge.

A contractor recounted: “We are now developing a template agenda for start-up meetings and linking it to our management system using appropriate tools. We raise the quality in the start-up phase of an activity or a project”. A project manager in a small design firm reported how processes were clarified in the company: “Our projects run from a few hours to, at the most, five years. We saw that we all ran our projects in different ways, which made it unduly difficult to communicate the status of the different projects to the each other. We therefore

developed a project management process inspired by systems in other companies. It resulted in an all-embracing process that suited our needs for most types of projects and contained a number of well defined sub-processes and tollgates.” A building materials manufacturer explained how his company tried to secure the hoists used to lift heavy concrete building blocks: “We tried to reduce the number of hoist variants. There is an abundance of various types of hoists and different designers prefer different types. But if we could reduce the number of hoist types, and preferably have one standard hoist, it would make things easier throughout the process; founders and armament workers would not have to figure out which hoist to use, and loaders could reduce their stock of different hoists, and so on all the way to assembly.”

It is widely felt that processes can be streamlined by increasingly using similar ways of working in the company. By using more efficient ways of working the number of unproductive tasks can be reduced and process stability increased.

Standardize information management tools (11)

Information management is central to creating order and clarity in projects and project information-management tools and systems are often developed in-house. Moreover, many IT consulting companies develop information management tools for efficient information

management throughout the project. The tools are often seen as useful, but problems arise when individuals have to learn to cope with new tools for every new project. Learning how to transfer data between the tools is especially problematic, which actors are constantly experiencing.

A designer expressed his frustration over the time spent in learning the systems of his customers, and compared this to the time actually spent on design work. Another designer said: “We need to collaborate with other designers using CAD. We have therefore adopted standardized software and installing routines: Pre-defined CAD packages for different specialists and standardized ways of working described in the CAD manuals. As a result cooperation in projects has become much easier. “A materials manufacturer told us of the need for standardized blueprints: “I consider that a logical, high-quality blueprint standard is one of the most important things for a company that uses blueprints as much as we do in the prefab industry. We have a standard that is simple and easy to use. The downside is apparent when we are short of designers and thus need outside consultants to supply the factory with blueprints to keep production running smoothly. As they always work on a very tight schedule and want to get the blueprints ready faster, they often don’t bother with quality. So I am searching for a Swedish blueprints standard that all certified companies could use. My company as well as many others would gain by this. Why does there

have to be five to ten different standards in the prefab industry alone? I can guarantee that if a common standard were adopted our waste would decrease dramatically and we would have less disruptions and shorter lead times”.

More long-term cooperation between companies would reduce waste that arises when different systems communicate with each other. A more likely scenario is that cooperation between companies will continue to take place mainly in projects. From this follows that authorities and business associations must take on the responsibility of standardizing IT.

Plan accurately and follow-up continuously (12)

Construction projects do not always turn out as planned. Daily occurrences are surprises and problems that require solutions that lead to re-planning. The follow-up of day-to-day plans shows that often only a half of the scheduled activities are actually completed on time. How then are project managers able to carry out efficient activities, e.g. to decide when materials and resources should be ordered without having to improvise and run the risk of substantial wastage? Delays during projects lead to rushing later on, which puts stress on those working in the concluding phases of production. Steering towards clear, broadly communicated milestones will result in a comfortable pace during the final stages. Major construction projects tend to go

over both time and budget.

Planning is one of the most important activities when structuring processes. Detailed and informed project plans with clear milestones should therefore be drawn and followed up. Ban surprises! More detailed planning reduces risks and uncertainties, which in turn lowers waste at several levels.

Minimize weather dependencies by means of pre-fabrication and weather protected assembly (13)

Weather, primarily rain and snow, leads to additional costs and creates the need for flexible production planning in many projects. Materials stored on site must be covered properly so as not to be damaged by moisture. Cold complicates some construction activities. Extreme cold will stop work completely. Snow clearance requires resources and causes production delays. Getting the roof and outer walls on place are prioritized to avoid problems with moisture in the structure and to enable work indoors. Rain and cold often deteriorate the work atmosphere.

Therefore, by reducing dependence on weather, there is a high potential to reduce costs. The lower risks of stoppages and materials waste simplify more accurate planning thereby further reducing uncertainties. Key alternatives for reducing weather dependence are to increase the proportion of prefabrication and to avoid intermediate storage of building materials. Another major

option is to shelter the construction. A functional shelter also provides opportunities to use alternative sequences in assembling.

Establish disciplined information structures and meetings (14)

More and more working hours are used to create and manage information. Our discussions with white-collar personnel show that many are to some degree frustrated over how data is managed. They recount how the same information is created repeatedly, e.g. that calculations are done several times, and by various people. This also means that information is lost.

These employees are also frustrated over how meetings are planned and carried out. They especially complain about the number and length of meetings. They often feel that only a small portion of the meeting is relevant, at least for themselves. The rest of the time is just wasted. Punctuality is also often mentioned, particularly in terms of those few people who arrive in time for meetings. Much time and frustration can be spared when meetings are better planned and carried out, especially considering the great number of meetings that are held in every company and project.

Here are some questions to consider before planning a meeting: Is the meeting really necessary? Can it be combined with other meetings? How can the length of meetings be reduced? Could it be completed in one

hour? In our discussions with the groups, the opinions on how to solve the meetings problem were straightforward: The project manager (or chairperson) should have an agenda making it clear who is responsible for each point, who is to respond and the time allocated for the point. If complexities arise, they should be postponed to separate meetings involving only those concerned.

Email is also a source of frustration. We often encountered the view that junk mail is easy to delete, but that “mail which requires me to open it and read it until I see that it has no relevance to me is the worst”. Surprisingly many feel themselves forced to read new mail as soon as it arrives and in so doing interrupt current work.

Our discussion resulted in very clear recommendations. Reflect over each mail and the recipient/s before sending it: Do all addressees need the mail? How much work will the mail entail for the recipient? Plan a specific time for reading e-mails: Could you limit this time to half an hour in the morning and then close your mail application for the rest of the day, or even better, avoid reading emails until the end of the day?

Structure supply flows for efficient assembly (15)

On many construction sites, materials handling and storage frequently give rise to problems. Restricted storage facilities, relocation of materials, searching for materials, disposing of materials and interruptions to unload new materials from a newly arrived truck is part of

daily life. In spite of this, production management more often than not underestimates the time spent on these tasks. In addition, the transport of materials to the site is a hidden process for many project and production managers. The cost of distributing and handling materials can be many times greater than the manufacturing cost.

Traditionally production is planned depending on when materials will be assembled, without taking into account when, where, and by whom the materials will be moved nor where they will be assembled. However, the assembly itself, i.e. the part that adds value to the product, only takes a short while. The cost of getting the materials to the place of assembly is much greater.

Project management should therefore focus more on how materials are moved to the assembly site. It is on the whole interesting to shift focus from assembly to materials supply. Production control could be strengthened and processes made more stringent and orderly. Thus, waste would be reduced, e.g. less physical workload, less stress and less storage space. Most interesting is that the skilled workers are freed to concentrate on the tasks they have been trained for. A contractor recounted his experiences: “For our project we hired an outside company to deliver the materials for inner walls and windows after normal working hours. This minimized transport disruptions during working hours. The materials are delivered “just-in-time” and the carpenters can concentrate 100% on what they are trained to do.”

5. Develop the organization and its capabilities

All kinds of performance are dependent on the competence of the individuals, or the group of individuals. Competence can be said to be composed of a number of building blocks, see Fig. 6. We can see that competence builds on knowledge and experience. Knowledge and experience in an organization are easy to influence, either by training or by recruitment. The building blocks of competence are intelligence, personal characteristics and values. Intelligence and personal characteristics are very difficult to change, but the values of individuals and groups can be influenced, even if it is difficult. Values therefore play an important role in reducing waste.

The importance of the organization and the leadership role for efficient and successful processes should not be under estimated.

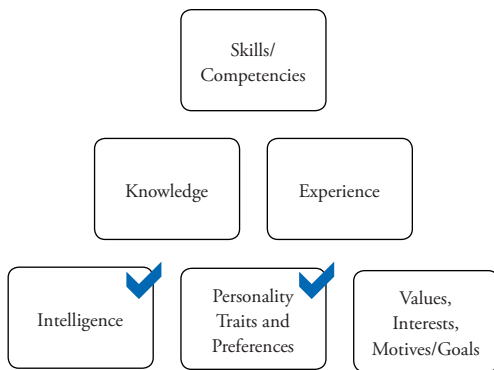


Fig. 6: The building blocks of skills (after Hughes, et al. 2006)

Develop the organization and its competence

The recommendations in this section aim to develop the organization and its members' competences. This also includes supporting the suppliers' development as success is highly dependent on the competences and abilities of the suppliers.

- Actively support suppliers in their development (16)
- Select employees with the appropriate skills and attitudes (17)
- Strive for aligned teams and project organizations (18)
- Consider new skills to meet new approaches (19)
- Encourage further training (20)
- Support the development of individual effectiveness (21)
- Plan in reflection and training (22)

Actively support suppliers in their development (16)

In many companies, suppliers account for the bulk of the turnover. This applies to e.g. clients, which buy 98-99% of the work, and to contractors, which purchase goods and services for 75-80% of their turnover. For these

companies the performance of the suppliers is decisive for the end result. Therefore, for long-term sustainable development, it is natural to actively support the development of the suppliers. In many other industries, this is self evident, whilst it is by traditional unusual within the built environment sector. This is illustrated by the following quote: “What do the contractor and the car manufacturer do when a subcontractor fails? The contractor pressures the supplier to finish, whilst the car manufacturer immediately sends five people to help the supplier”.

Fewer suppliers and more long-term relationships increase possibilities to support suppliers. A company should prioritize those suppliers that are most important in terms of volume or importance as well as those for which the contractor is their largest customer.

Select employees with the appropriate skills and attitudes (17)

The composition of an organization is extremely important to achieving good results. In sports the importance of individual excellence and how individuals are combined to form a team is abundantly clear. The team is built to function together in all matches over a number of years. In the same way, the competence and composition of project groups are decisive for the end result. Already before project initiation, business executives are able to predict, based on the organization and other circumstances, how well a

project will succeed.

The following examples from one of our discussions reveal an obvious lack of regard to experience in the recruitment of project manager:

Leader 1: We have the opportunity to let the site manager take care of the next phase. But do you think we do it? Nope..., not even when we would only need limited resources to guarantee better production do we do it.

Leader 2: I have sold four multi-storey car parks consecutively. Four different design groups made blueprints, instead of the first group doing all four and using experience from the first project in the next.

To reduce waste it is also important to consider the attitudes and the potential for improvement of different individuals when recruiting and staffing. This is about the ability – and the desire to develop the ability – to understand one’s role in increasing customer value. This is also about the ability – and the desire to develop the ability – to understand what adds value and what does not.

Strive for aligned teams and project organizations (18)

Our previous studies on defects and the associated costs (e.g. Josephson and Hammarlund, 1996) show a clear link between an organization’s composition and the cost of correcting the defects that appear. The projects with aligned teams have lower defect costs than those that are composed

of individuals and groups that have not worked together earlier. By aligning teams we mean both aligning work teams and as aligning project organizations.

Aligned work teams and project organizations imply not only that both uncertainties and risks are reduced due to the existence of various forms of communication in and between teams. Moreover costs and lead times may be reduced when less time is needed to getting to know and understand each other.

Consider new skills to meet new approaches (19)

Projects have been manned according to the traditional way of identifying customer needs and transforming these into plans of action, and then working according to these plans.

With new perspectives on the meanings of customer value, efficient processes and reduced resource consumption, new skills are required to reduce long-term and short-term waste. Here are some examples:

The largest consumption of resources – as well as the largest increases in value – take place on the construction site. Therefore the role of site manager should be entrusted to well-trained and capable individuals. The role of site manager on projects with a turnover above MSEK 100 should be considered the primary career goal for well trained individuals. The role should be highlighted and given higher status in

construction companies. Similarly, necessary technical production skills are required.

Companies in many lines of business invest heavily in buildings and premises that are best suited for their activities. Given this, the competence of clients' project managers should be reviewed. Currently these are recruited largely from contractors.

Earlier we recommended an increased focus on supply flows, partly because transport and other handling of materials constitute a large proportion of the total resource use in construction projects, and partly because well-planned supply flows can contribute to structuring production processes. This implies a need for individuals with logistics expertise.

Common to all employees in the company and the projects is the ability to understand who or what their customers are, and how they bring value for these customers. The ability to see what is and what is not value-adding in the processes they participate in is important.

Encourage further training (20)

Nearly all continued training takes place in a work situation. This means that skilled workers mostly train in “real” situations, together with their closest co-workers.

Learning in the form of courses, seminars, etc. is in itself not value-adding. Often these forms felt to be too generalized and hard to put into

practice in one's own work situation. They do not provide possibilities for reflection and discussion with others in the same work situation or with those in other fields of knowledge. So further education makes it possible to understand how people's efforts may increase customer value. Such competence development is crucial if they are going to contribute to reducing waste in their activities.

Suitably planned education can also lead to that specific operations, ways of working, improvement programs, etc. are developed within the framework of the course.

Support the development of individual effectiveness (21)

It is well known that managers in general have fragmented workdays. Minzberg (1973) contended that managers change tasks 600 times during a workday. Systematic studies of designers, site managers as well as of construction workers and installers confirm that a fragmentation of the workday is prevalent irrespective of work role. It is above all the white-collar workers that feel frustrated over their fragmented workdays. Their work is often interrupted by unforeseen problems in need of solving.

The understanding of how one's workday looks is mostly quite limited. Systematic studies of people's daily work usually surprise by exposing the small amount of time actually given to value-adding work. A mid-level manager who was asked

to monitor his workday reported that: "I started monitoring one day, but saw that I created so little value that I continued the next day. It ended by my monitoring the whole week, and I was still unable to see that I actually added any value whatsoever to the end product".

Everyone can control what his/her work time is used for. One recommendation is to plan the day and then strive to follow this plan as strictly as possible. Another recommendation is to avoid time thieves, e.g. one should restrict oneself to reading e-mail once or twice daily. Many small reductions in non-value-adding activities can add up to give considerable cost reductions.

All employees have a duty towards both customer and employer to increase their personal effectiveness. But it is the duty of management to stimulate and support every employee in this endeavor.

Plan in reflection and training (22)

All employees work intensively so as to accomplish the planned work done as effectively as possible. Many experience stress during their workday. Simultaneously they ask for time for reflection. The majority of our talks with practitioners, irrespective of whether they were white or blue-collar workers, revealed a desire for time to reflect over work tasks and discuss experiences with fellow workers.

Reflection usually takes place during coffee and

lunch breaks as well as during various types of companywide meetings. It also takes place during continuation courses. However, occasions for reflection in order to develop the whole organization are seldom organized or planned.

Time should therefore be set aside for reflection and knowledge exchange in project plans, so that proposals to increase efficiency may be captured. After the project, time should be devoted to document lessons learnt so that long-term development may be supported.

Discipline management

As management is such an important factor in achieving change, we decided to highlight it as a separate area. It is important to adhere to a long-term strategy to bring stability to the organization, as well as to systematically increase efficiency. Management and reward schemes should be in line with overall goals and strategies, and not lead to misunderstandings.

Swedish leadership is characterized by giving employees a great deal of freedom in their work tasks. However, to reduce waste, this freedom should be streamlined and disciplined on many fronts. Management often thinks short-term. Long-term thinking should be given more space.

- Base management decisions on a long-term philosophy (23)
- Strive for order and neatness at the

workplace (24)

- Give clear instructions, which cannot be misinterpreted (25)
- Set high standards that drive development (26)
- Reward good work (27)

Base management decisions on a long-term philosophy (23)

Operations in the construction sector are largely shortsighted. Companies listed on the stock exchange are expected by owners to deliver good quarterly results. Project oriented companies expect every project to be profitable. In buying services for projects, clients and contractors consider price levels more important than long-term collaboration.

Toyota, Scania and IKEA are often named as exemplary companies. Common to these companies is that all management decisions are based on long-term philosophies. A typical answer from a Japanese executive when asked what is most important for his company was: “to be a thriving business in 50 years”.

Reducing waste requires significantly more long-term thinking. For example, one should create relevant goals that will stand the test of time and survive management changes and economic fluctuations. This will provide stability to the organization and security to the employees.

Making those kinds of decisions requires marked determination and courage in both owners and management.

Strive for order and neatness in the workplace (24)

The level of order at the work site dictates the quality of the work done. A noisy and untidy workplace increases the risk of carelessness, which results in waste. A clean, well-structured workplace supports employees in their work for greater precision.

A clean, well-structured workplace simplifies information transfer, increases employee job satisfaction and reduces the risk of occupational accidents and diseases. In such a place people, materials and equipment may move more efficiently. The time needed to search for information, materials, etc. will be reduced. The risk of information loss and materials waste is reduced.

Furthermore, the company image will also be influenced. There are therefore many reasons to give priority to order and neatness in the workplace. Managers and project managers are the ones to set the level of achievement.

Give clear instructions, which cannot be misunderstood (25)

The products produced in the construction sector are extremely complex. They require large amounts of information to be transferred between

individuals. The risk that any single piece of information or a task will be misunderstood is high. Communication problems are also often mentioned as key problems in construction.

One recommendation is to create routines for how existing communication tools should be used by the employees. This refers to how managers at all organizational levels express themselves in speech and writing. It is essential that managers have the ability to identify what information is important and what is less important, to be able to transmit it in an unambiguous manner, and to follow up in a reasonable way whether the information has been correctly understood.

Supervisors should give clear instructions as to how the task should be performed and the performance levels that apply. For construction, site managers should e.g. clarify how the insulation should be installed for maximum water-tightness and surface layers precision.

Set high standards that drive development (26)

The current debate reveals a broadening desire for products that meet high environmental-impact standards, e.g. for energy consumption. The debate also reveals a more noticeable desire for manufacturing processes, which meet specific ethical and moral requirements.

Both the skills to develop the products and manufacturing processes to meet these requirements exist, but there is also a strong

resistance to change. Authorities, customers and business leaders put heavy demands on the critical key factors driving change. Set high standards for e.g. energy consumption in completed constructions to drive new smarter solutions. This in turn leads to a focus on activities that increase customer value.

Reward good work (27)

The wage and promotion procedures send clear signals about what is considered important in an organization. Therefore, they should be designed to steer the efforts of the employees towards the set goals. When the incentives reward efforts going in the wrong direction the risk of sub-optimization is high, as the following quote by a head of R & D highlighted: “We measure our performance in comparison with our immediate superior. For that is what governs our salaries. And so we always pursue the lowest visible cost - not the lowest overall cost seen over the long-term nor the maximum profit for the company in a long-term perspective”.

A number of weaknesses in today’s payroll systems have been noticed, especially those that apply to production work. Two examples are extensive administrative costs associated with piecework bargaining and an excessive focus on time at the expense of quality. A product manager highlighted how these problems were associated with planning and employee development: “They have been employed on a project basis and we

have not bothered to develop them. So what can they do to profit in any way? Only to keep on working for piece wages as well as possible because there is no personal development and no differentiated pay”.

Remuneration schemes should therefore be designed to create incentives for employees to aid in all ways so that project and company goals are met. One way to achieve this is to make greater use of systems that reward work well done for the benefit of the company in the long-term.

6. Implement gradual improvements

Based on employee knowledge and experience from completed projects, there are clear opportunities for both the sector as a whole and individual companies to develop efficient and profitable processes with minimum waste. However, the general view is that the transfer of knowledge and experience between individuals and between projects is limited.

A prerequisite for carrying out gradual improvements successfully is for companies to develop similar ways of working in their projects (factories, etc). This will enable relevant comparisons as well as strengthen the learning of efficient resource use.

Measure to uncover of waste and to control improvement measures

To significantly reduce waste, companies should work in a structured way on a long-term basis, and with carefully selected activities. Most companies and organizations in the built environment sector are “immature” in the sense that they have no understanding which activities in their operations are value-adding and which are not. They should quantify the volume of waste in order to stimulate improvement efforts. The “mature” organizations have such systems and an interest to pursue successive improvements. In order to control improvement measures, it is more beneficial to follow-up and identify where there may be waste.

- Measure in order to uncover waste (28)
- Measure to control improvement work (29)

Measure in order to uncover waste (28)

If all the waste were visible, it would probably be dealt with when it appeared. The problem is that almost all waste is invisible, or rather, employees have no ability to understand what provides value to the customer and what does not. Therefore systematic analysis of the individual processes is required to render waste visible.

Few tools are available to highlight waste. One simple tool is work sampling studies, used to follow up what the resources (primarily people and machines) are actually used for. Work sampling studies can be carried out on top management, middle management, skilled workers, on officials at public authorities, on researchers and even on politicians. The purpose of work sampling studies is to gather data that exposes waste. This will stimulate change.

Another tool is the “value flow analysis” in which processes are followed over time. One example is to monitor the detailed planning process and to note the minutes/hours devoted to relevant planning, i.e., disclose when value is added. Another example is to monitor casting on site and to note the seconds/minutes when concrete does actually flow into the form. The results of the survey are reported on a diagram and the percentage of customer-value-adding time is

calculated. A closer analysis yields a profile of the process and which instances of waste, e.g. lag time, can be eliminated to shorten the lead time.

Reducing waste is very much about developing an understanding of what does add value and what does not. It is therefore important in both type of analyses – work sampling analysis and value flow analysis - that those who are involved in the process being studied also take part in the analysis.

Measure to control improvement work (29)

Successful improvements are based on facts. Companies and project organizations generally follow up costs and revenues effectively. Regular surveys of how customers perceive the products delivered and how employees perceive their work situation are common. However, in most companies and project organizations systematic monitoring of operational activity and resource efficiency is nonexistent.

The purpose of monitoring is generally to give an indication when something is wrong, to indicate what the problem is, explain why the problem occurred, and in some cases indirectly indicate how the problem may be corrected. In order to be relevant, monitoring should be as closely tied to the value-adding process as possible. Since construction and real estate activities are generally carried out in project form, monitoring should be used in the projects.

In its simplest form, monitoring is limited to a few questions after the project has been completed. In more advanced systems, data can be collected, analyzed and reported back several times during the project. When this should be done depends on when the information is available and when it can be used to drive change in the project. In conjunction with the start of the project, conditions such as project goals and organizational skills can be evaluated as part of the risk analysis. During ongoing projects, for example, leadership and employees' commitment can be monitored. After project completion, results such as customer value, project goal fulfillment, productivity and a summing-up experience should be evaluated and documented.

With a well-functioning project monitoring system, information can easily be aggregated to provide an overview of the region's or company's total project activities.

Use experience to streamline resource use

During improvement processes, companies should be careful that the measures undertaken do not lead to increased costs in other areas.

- Collect and use best practices systematically (30)
- Link all improvement initiatives to product characteristics or to value-adding processes (31)

Collect and use best practices systematically (30)

Given how many assignments or projects each company carries out, there are obvious opportunities for the company to develop efficient processes with minimum wastage and good profitability. However, transfer of knowledge and experience between projects is generally viewed as limited. One reason is that project members rush to the next project as soon as they have completed the previous one and fail to document the key lessons learnt. Another reason is that companies have failed to develop methods to collect, transfer and especially to apply their experiences in a systematic way.

A common mistake is to create unnecessarily complex systems of experience transfer. Most companies would go far enough by first ensuring that after completion of the project, each project manager documents the most important experiences in three areas. These can be: customer relations, their own project organization and the product. It is also very important that in the planning and start-up phases of subsequent projects, a combined list of previous experiences is reflected upon. For a company that runs 50 projects yearly, this will make a list of 150 new experiences each year.

Thus, gather the best practices and acquired experiences systematically in the end of every project and use these in subsequent projects! Furthermore, ensure that relevant experiences are

transferred to customers and suppliers!

Link all improvement initiatives to product characteristics or to value-adding processes (31)

In most companies and organizations, employees have a relatively large freedom to make improvements on their own initiative. This is usually advantageous as the improvements are connected to the individual's own work. However, it is of doubtful value when the initiatives concern changes to other people's activities. The problem is that currently a surprising number of improvement initiatives are implemented without establishing what waste, if any, is eliminated.

It is popular to implement administrative systems and management systems in public authorities, businesses and other organizations. These systems are often warranted and well thought out, but they tend to be developed without links to the value-adding process.

Improvement work in itself is not customer-value-adding. It must be clearly linked to changes in product characteristics or to changes in the process for it to be of value.

Part III

Conclusions and Reflections

7. Conclusions

Lead and structure to reduce waste (What?)

We have consistently argued for reducing the unnecessary consumption of resources, for reducing waste. This is necessary to achieve real and lasting cost reductions.

We noted earlier that there are five main reasons that explain why resources are used unnecessarily. We illustrated these in the form of a “value pyramid” where the holistic approach is the apex. Structure, culture, competence and leadership are the corners of the foundation that makes the pyramid stable. If a corner of the foundation were to give way, the pyramid would risk toppling over.

Managers control operations and are ultimately those who influence how effectively the business is run. In other words, it is the manager who determines how strong the foundation of the pyramid is. All managers, whether of large groups or of small projects, share two important roles: leadership and management. To lead is connected with a leader’s personal qualities and behavior and is rooted in values, motives and self-perceptions among employees. To lead is, then, how we influence employees’, and suppliers’, attitudes and values. Managing concerns the behavior of a person who has a formal role in the organization, such as planning and coordination. Managing involves creating orderliness.

In order to reduce waste, we should henceforth differentiate these two roles. The leader must

therefore realize when he/she is leading, which influences employee attitudes and values, and when he/she is managing, i.e. creating order. Figure 6 illustrates how a leader may strengthen the foundation, which can then lead to reduced wastage. One alternative is to lead, that is to create long-term visions (leadership), clarify common goals and values (culture) and enable all employees to understand their role in the activities (competence). Another option is to manage, i.e. plan (structure), develops employees (competence) and to clarify responsibilities (culture). All organizations, regardless of the activity in which they are engaged, need leaders who lead and provide structure. Depending

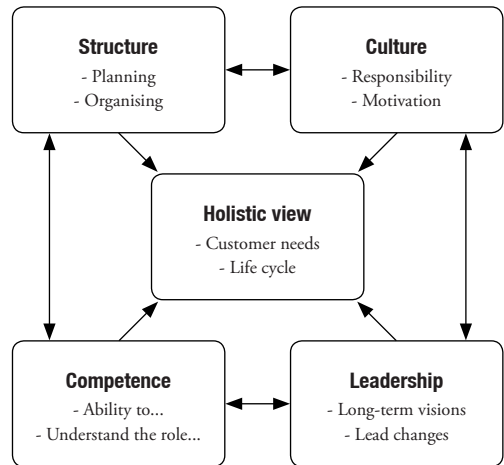


Fig. 6: Waste is reduced by leading and managing for increased accuracy.

on the situation, such as task complexity and competence in the organization, one of these roles may be larger than the other.

There are other reasons why these roles should be in balance. Managing often entails limiting the employees' freedom: leading does not limit in the same way. One of the risks of modern leadership prevalent in the West, not least in Sweden, is that employees enjoy too much freedom and flexibility. Several researchers, including Strannegård and Rappe (2003), have warned that the Swedish model of leadership is likely to result in mental illness for more and more people. Setting reasonable limits for employees, increases accuracy at the same time as it reduces the risk of ill-health, one of the largest sources of waste.

Obviously everyone is responsible for reducing waste (Who?)

It may seem obvious who or which party is responsible for eliminating different types of waste. However, the system that holds sway in business, industry and society leads to a certain distribution of power which controls everyone's incentives. The following issues are therefore relevant:

- Who has the power to reduce waste? Who runs the formal and informal rule system?
- Who has the economic incentive to reduce waste? Who will win by waste being

reduced? Today who is footing the bill for waste, i.e. the extra resources expended?

- Who is affected by waste?

Authorities, managers and project managers control rule systems

Ultimately, authorities control the systems of rules in the nation, managers control the rule systems within a company, and project managers control the rule systems of their respective projects.

The authorities should be in charge of improvements related to waste where society as a whole deals with the consequences even if the deficiencies are in companies or projects. The clearest examples are health and safety. Here society deals with most of the consequences of work-related injuries and illnesses. Another example is crime.

Currently the competitive situation is rapidly changing; borders are being opened to an increasingly global market. From a nation's perspective, it is highly desirable for companies to help each other to drive the standardization processes, e.g. for component interfaces and inter-company information transfer systems.

Authorities, managers and project managers have the power to reduce waste. The authorities have the opportunity to make demands that push the trend towards lower resource consumption, e.g. energy consumption. Business leaders have strong possibilities to influence employee values, e.g.

a long-term attitudes, and skills development, e.g. training systems. They also have the power to direct the development of similar ways of working in their projects. Project managers can communicate project goals and affect employee attitudes and values. They also control project staffing and planning.

Customers finance waste and overlook hidden profits

Ultimately, customers fund waste. They should therefore choose suppliers based on competence, past performance and established operational cooperation rather than on price. They should also prioritize identifying and communicating their needs clearly.

Companies (as suppliers to their customers) lose potential profits if they do not have a long-term outlook in line with the recommendations we have presented.

Everyone experiences waste

Since everyone experiences waste, everyone has at least some incentive to reduce waste. For example, individuals can increase their well-being by avoiding work that no one has requested.

Learn to recognize waste (How?)

We have identified a number of common instances of waste in construction-related activities. Subsequently, we investigated what

businesses and other types of organizations should do to reduce waste. How companies should proceed depends on the situation they find themselves in, i.e. the current state of the organization, structure, competitive position and market circumstances. This is precisely the problem the company management has been appointed to solve. However, the efforts to reduce waste in a business should always start with the individuals. Here we therefore present some simple suggestions how you can begin. To help you understand what is at stake, it is advisable that you begin by studying your own situation.

Carefully observe your workday. The largest obstacle to improvement is to expect others to change their behavior and activities. Another trap is planning changes that are too extensive and radical. Begin, therefore, by examining what you really do during a workday, e.g. next Monday. Divide the work time into three groups: value-adding work (green), preparation (yellow) and waste (red). Odds are high that the share of the value-adding work is less than what you had expected. Perhaps you will continue to investigate what you do, i.e. how you use your work time, for during the remaining four days of the work week to obtain a clearer picture of how you use your time. Knowing one's own work pattern often leads to some quick decisions, e.g. to better plan your work and give higher priority to that which is most important to get done. If you are a white-collar worker you will probably change your views

Organizational level	Examples of actions to reduce waste
Customer	Choose suppliers based on competence (not price) Clearly identify and communicate needs Clearly state requirements
Authorities	Simplify the rule systems. In many companies each simplification produces results Set high standards that drive development, e.g. on energy consumption Improve safety and security
Industry	Improve workplace safety Standardize management systems Standardize components
Management	Adopt a long-term approach Develop similar ways of working Develop staff skills
Project managers	Communicate project goals Work with individuals' attitudes and values Organize and plan
Individuals	Develop personal effectiveness Aim for well-being Question operations which are clearly seen as waste

Figure 7: Who will run what?

on how to conduct meetings and how you deal with email.

There are three good reasons why you should start with yourself and your own time. Firstly, you can actively take steps to reduce waste and get rapid feedback on the changes made. No one but you need be involved in the decisions. Secondly, it can have a positive impact on your work situation by reducing stress, for example. Thirdly, you will be in a position to share your experiences when you embark on the next phase.

After you have gained an understanding of your own waste, the next phase is to raise awareness among fellow employees, those within your own work group, department, project, about what is value-adding and what not. Take the opportunity to, at appropriate times and in an appropriate manner, to question whether there is a real need for the report a colleague is about to write, to suggest that it might not be a bad idea if all of you would plan your projects in a similar manner, or to talk about changes you have made. In this way, more of your colleagues will be inspired to start thinking about improvement opportunities, which will result in a more organized way of planning the hunt for waste.

Analyze the company's situation. Another suitable exercise for you and your co-workers is to analyze the situation in your business unit. Feel free to use some of the tools and methods that have been developed to identify, sort and rank waste,

in order to determine and analyze the causes of waste, and to develop and rank corrective measures. Try out the simple analysis tool we have developed to obtain a quick answer how your products, processes and organizations relate to our 31 recommendations, see Appendix 2.

Basically what we have attempted to do is to rely on facts to create a shared understanding among employees of the company's mission and its role in society. This is where the power to bring about significant and lasting changes lies.

Often when we provide examples of waste, we are met with astonishment over how much there actually is. It is important to learn to recognize waste. Compare with the ornithologist, who sees many of birds while the rest of us hardly see any, or the experienced mushroom picker, who finds many chanterelles, while the rest of us do not see any before they are in the basket. Similarly, how many of us have been trained to recognize both efficient processes and waste?

8. Some reflections

How much can we actually improve?

We are often asked “how much can we cut costs by?” or “how much can we improve?” The answer is simple: “We do not know”. The situation is different for different organizations and no one has ever tried to find these limits. Let’s divide the question into separate parts: cost and time.

In our last report we urged companies in the built environment sector to adopt a common vision to eventually halve the cost of production. Theoretically it is possible to halve production costs within ten years. In practice it is much more difficult. For individual activities or sub-processes the cost can be halved relatively quickly and easily. Other activities and sub-processes may be more or less perfect. Individuals can similarly save a lot of time by prioritizing the most important tasks, while other individuals already have a well planned and structured (efficient) workday.

Theoretically it is possible to shorten lead times significantly. By utilizing all the day’s 24 hours, design and production can be carried out in a quarter of the time it currently takes without a single person becoming more stressed than is the case today. The planning process, which we used as an example earlier, can almost certainly be implemented in less than one tenth of the time currently used without limiting the stakeholders’ opportunity to intervene.

It is interesting to study firms that carry out many

similar tasks for the same client. For several years Wäst-Bygg built all the McDonald’s restaurants in Sweden. Over this time there evolved a relatively standardized product, a standardized process and a coherent organization with largely the same members and suppliers. Wäst-Bygg assessed that their construction times were halved, from 16 to eight weeks. The restaurant by the Øresund Bridge was built faster, in four weeks. Construction costs were reduced by 25-30%.

Hence, there are real life examples which show what it is possible to achieve. A reasonable target is to reduce production costs by 25% within a period of fifteen years. However, this requires long-term, consistent, targeted and systematic improvement work. Will NCC Construction manage to reduce their costs by 5% per year from 2008 to 2012? Is it at all possible? If we start from the amount of resources consumed and evaluate all resources of the same type alike it is probably not possible. Yet it is a good vision. It stakes out a clear direction for employees, suppliers and customers to take.

Shall we emulate the Japanese management style, or the American, or ...?

Often we refer to Toyota and Japanese management when discussing long-term and systematic improvement. Lean, Just-in-Time, Total Quality Management, Kaizen are some management philosophies that are strongly

associated with the Japanese industry. Common to these philosophies is the will to minimize waste. Let's look at what two "management gurus" with deep insight into the Japanese approach.

Walter Deming (1900-1993) contributed to raising interest in quality. He suggested that variation creates waste. He formulated 14 management principles, which were further developed later on. Bergman and Klefsjö (1995) believed that Deming's principles embodied what we now consider the Japanese leadership ideals. Deming's principles differ substantially from our 31 recommendations.

Jeffrey Liker, an American professor, studied Toyota's production system for 20 years and published the best-seller "The Toyota Way" (Liker, 2004). In it he formulates 14 principles on which Toyota's production philosophy is founded. An important point of departure for him was to examine processes from the customer's point of view and ask oneself what the customer really wants. There is a lot of similarity between Liker's principles and our set of recommendations, for example starting with the customer's point of view and focusing on eliminating waste. One difference is that Toyota's production philosophy concerns solid industrial and factory production while our recommendations concern project-oriented activities. Liker focuses on the organization and its processes, touches upon leadership and improvement, but does not mention the product. Some common recommendations are: basing

decisions on long-term philosophy, standardizing data as a base for continuous improvement, employee development, and becoming a learning organization through reflection and continuous improvement.

Both Liker and Deming base their recommendations on the conditions prevalent in Japanese culture e.g. operations and management in accordance with conditions that exist in Japanese culture. How similar are the Scandinavian and Japanese cultures?

The Dutch researcher Geert Hofstede conducted extensive studies on national cultures, i.e. the values prevailing in societies. He believes that Japanese people generally have a greater acceptance of uneven power distribution and a lower degree of individualism than do the Swedes. More interesting are the large differences between these cultures concerning their views on "masculinity". Japanese society is extremely masculine in that men are more dominant and seek material success while women strive for high quality of life. Swedish society is the opposite, extremely "feminist", which refers to both men and women largely seeking high quality of life before material success. Minimizing risks is also inherent in Japanese culture. The Hofstede study confirms the need in Japanese society to establish formal and transparent regulatory systems to avoid uncertainties. The same need does not apply to Swedish society. Japanese society possesses a high long-term orientation, while Swedish society

is clearly short-sighted in its actions. In Figure 8, the values for the United States are included for comparison. This because Swedes read mainly U.S. management texts.

The Hofstede study clearly shows that Japanese society more easily adopts risk-and uncertainty reducing programs. Because values change slowly, Swedish companies operating in Sweden with predominantly Swedish employees cannot ‘mimic’ improvement programs developed in the Japanese culture. For the same reason these companies cannot “imitate” American development programs.

Swedish companies must be based on the values that characterize Swedish culture. They should learn from the long-term orientation and risk reduction that is characteristic of Japanese culture, but also find ways to exploit the tradition of working in situations of uncertainty to use it as a competitive advantage.

Understanding waste creates new business opportunities

Consider the following two questions:

- Have you developed an understanding of how a client’s money flows through the system of companies and other organizations and where in this system each Swedish crown is consumed?
- Have you developed an understanding of what resource use creates customer value, i.e. what adds value to the product, and what consumption of resources does not create customer value?

If you answer yes to both these questions, you have great opportunities of finding new competitive advantages and even new business opportunities!

Factor	Sweden	Japan	USA
Power distance	31	54	40
Individualism vs. collectivism	71	46	91
Masculinity vs. femininity	5	95	46
Low vs. high uncertainty avoidance	29	92	54
Long- vs. short-term orientation	33	80	29

Figure 8: Similarities and differences in national cultures (Hofstede and Hofstede, 2005). Low numbers mean low power distance, collectivism, femininity, and short-term orientation.

A good example is Urban Wallin, who, has transported construction materials to construction sites for several years. He reacted strongly to how disorganized materials reception procedures were and the large waste this led to. About ten years ago he founded Svensk Bygglogistik aimed at helping construction companies receive construction materials and move it to the work site after 16:00 when all construction workers, electricians and others had completed their work for the day. He could use the cranes and other equipment already in place and unused. No one got in the way or interrupted the work routines. Today the company has developed more comprehensive logistics solutions.

There are many competitive advantages and business opportunities that still remain unexploited. These could contribute to rendering resource use in the built environment more effective and simultaneously solving customer problems. Reflect a moment on the following questions:

- What work is silent? What work can be carried out between 16.00 and 06.45? What can machines and other equipment be used for during this time?
- What can centrally located offices be used for between 18:00 and 07:00? Attractive housing? The premises are already heated (or cooled), and probably have toilets, showers and kitchens as well.

The first example is relevant today. The second example will perhaps be a reality tomorrow. List additional questions and conduct a brainstorming session with a few colleagues.

A sense of freedom and the competitive situation?

The desire to increase precision at each stage clearly signals the need to standardize products, processes and organizations. Standardization often has negative connotations in everyday speech. However, it is important to realize that construction and building activities are already standardized in many respects, and that the frustration that individuals at different managerial levels and in different companies express may in fact be a call for increased standardization. Compared to many other industries, e.g. the automotive industry, construction still enjoys a broad freedom. The process of standardization must therefore continue amongst Swedish construction-related companies if they are to increase profitability and meet the challenges presented by global competition, climate change and the work environment.

Standardization gives rise to at least two key questions: first, what should be standardized? That is, what should be standardized without affecting an individual's sense of freedom? This feeling of freedom is valued in Swedish culture. Second, when should companies collaborate and when

should they compete? That is, which components, technologies and sub-processes should be standardized at the project level, at the business level and at the industrial level?

9. References

- Bergman, B., and Klefsjö, B. (1995) Kvalitet från behov till användning, 2a upplagan, Studentlitteratur, Lund.
- Byggnads (2002) Rapport om arbetsmiljö och ekologiskt byggande till kongressen 2002. Available at www.byggnads.se, the Swedish Building Workers' Union.
- Byggsektorns kretsloppsrad (2001) Byggsektorns betydande miljöaspekter – Miljöutredning för byggsektorn, Slutrapport 2001-01-31. Available at www.kretsloppsradet.se.
- Carlström, A., Lantz Hedström, H., and Heber, A. (2007) Organiserat svartarbete i byggbranschen, Brottsförebyggande rådet, Brå Rapport 2007:27, Stockholm.
- Deming, W.E. (1986) Out of the crises. Cambridge University Press, Cambridge, Massachusetts.
- Ericsson, L.-E., Liljelund, L.-E., Sjöstrand, M., Uusmann, I., Modig, S., Ärlebrant, Å., and Högrell, O. (2002) Skärpning gubbar! Om konkurrensen, kostnaderna, kvaliteten och kompetensen i byggsektorn, Byggekommisionen, SOU 2002:115, Stockholm. Available at www.regeringen.se/content/1/c4/16/49/263cc131.pdf.
- Forsblom, M., Larsson, T. J., Oldertz, C., and Paulson, P. A. (2007) Allvarliga arbetsskador och långvarig sjukfrånvaro 2007, AFA Försäkring, Stockholm. Available at www.afaforsakring.se.
- Hofstede, G., and Hofstede, G.J. (2005) Organisationer och kulturer, 2:a upplagan, Studentlitteratur.
- Hughes, R., Ginnett, R., and Curphy, G. (2006) Leadership – enhancing the lessons of experience, 5th edition, McGraw-Hill.
- IPCC (2007) Climate change 2007: Synthesis report. Contribution of working groups I, II and III to the Fourth Assessment report of the Intergovernmental Panel on Climate Change, IPCC, Geneva, Schweiz. Available at www.ipcc.ch/ipccreports/ar4-syr.htm.
- Josephson, P.-E., and Hammarlund, Y. (1996) Kvalitetsfelkostnader på 90-talet – en studie av sju byggprojekt, Del I: Resultat, Report 49, Inst. för byggnadsekonomi, Chalmers University of Technology.
- Josephson, P.-E., and Saukkoriipi, L. (2005) Slöseri i byggprojekt – behov av förändrat synsätt, FoU-Väst RAPPORT 0507, Swedish Construction Federation.
- Josephson, P.-E., and Saukkoriipi, L. (2007) Waste in construction projects – call for a new approach, The Centre for Management of the Built Environment (CMB), Chalmers University of Technology. ISBN 978-91-976181-7-5. Available at www.chalmers.se/cmb.
- Konkurrensverket (2007) Asfaltkartellen – den största kartellen i Sverige, 2007-07-02. Available

at http://www.kkv.se/t/Page____465.aspx.

Liker, J. (2004) *The Toyota Way, 14 management principles from the world's greatest manufacturer*, McGraw-Hill.

Minzberg, H. (1973) *The Nature of Managerial Work*, Harpercollins College Div.

Mårald, E. (2007) *Svenska miljöbrott och miljöskandaler 1960-2000*, Gidlunds förlag, Hedemora.

RSV (2002) *Svart arbetskraft inom byggbranschen – Utredning avseende skyldighet att göra skatteavdrag för underentreprenörer*, RSV Rapport 2002:6. Available at www.skatteverket.se/omskatteverket/rapporter.

Samuelson, B. (2004) *Förtidspensioneringar inom bygg- och anläggningsindustrin – en jämförande registerstudie*, BCA 2004:1, Byggindustrins Centrala Arbetsmiljöråd, Stockholm. Available at www.bygg.org/statistik.asp.

Samuelson, B., and Andersson, B. (2002) *Varför lämnar byggnadsarbetare branschen – en enkätundersökning*, BCA 2002:1, Byggindustrins Centrala Arbetsmiljöråd, Stockholm. Available at www.bygg.org/statistik.asp.

Samuelson, B., and Lundholm, L. (2007) *Arbetsskador i byggverksamhet 2006 – privat och offentlig verksamhet*, BCA 2007:1, Byggindustrins Centrala Arbetsmiljöråd, Stockholm. Available at www.bygg.org/statistik.asp.

Samuelsson, I., Mjörnell, K., and Jansson, A. (2007) *Fuktskador i putsade, odränerade träregelväggar – lägesrapport oktober 2007*, SP Rapport 2007:36, SP Sveriges tekniska forskningsinstitut, Borås. Available at www.sp.se/sv/index/services/puts/Sidor/default.aspx.

Statistics Sweden (2010) Data available at http://www.scb.se/Pages/TableAndChart____26944.aspx.

Stern, N. (2006) *The Stern Review on the Economics of Climate Change*, Cambridge University Press, Cambridge, Great Britain. Available at www.hm-treasury.gov.uk/independent_reviews.

Strannegård, L., and Ensjö Rappe, T. (2003) *För mycket frihet gör anställda sjuka*, Dagens Nyheter, 19 January, p. 4.

Appendix 1: 31 recommendations

I Standardize the product from an overall perspective

1 Base product definition on running costs

Take into account all anticipated costs during a product's life cycle. An office building may, for example, have a maximum cost that includes operational costs, maintenance costs and investment costs.

2 Prioritize sustainability in system choices

The products created in the construction industry tend to become increasingly complex. Prioritize the choice of systems to achieve for better design and manufacture structure, as well as use.

3 Develop technical solutions that can be used for several products

There is a tendency to consider every new project unique, for which the organization should create new, untested technical solutions. To shorten lead times and reduce risks, standard solutions that can be used in several products should be developed.

4 Reduce the range of components

Reduce the number of similar components in different projects. In many cases, neither the function nor the appearance is affected. The cost of handling, management and inventory will be reduced, as will be the risk of faults.

5 Standardize components

Standardize and simplify components and their

functions. Also develop standard solutions for the interfaces between the various building elements, such as joining a glass front to a brick wall or window sheets around windows.

II Define and standardize the process

6 Define the factual customer requirements

Prioritize and organize work to identify both stated and implied needs and requirements, and translate these into concrete detailed project goals. Probably the worst kind of waste is buildings and structures that do not support the client's activities.

7 Oversee that all project members know and understand project goals

Ensure that all employees know and understand the objectives of the mission and operation. This is a prerequisite for getting them to work in the same direction thereby minimizing the risk of wasting resources on activities that do not lead to increased customer satisfaction.

8 Seek long-term customer-supplier relationships

Choose customers and suppliers that you wish to have a close and long-lasting partnership with. There are obvious opportunities to develop a single efficient process when two companies jointly seek to understand each other's circumstances and capabilities.

9 Use all of the week's 168 hours

Every construction project entails a major investment for the client. There are therefore good reasons for completing the product in the shortest possible time. Analyze activities to find those that may be performed outside normal working hours.

10 Develop similar ways of working

Based on best-practices, successively develop common ways of working in company assignments, factories, etc. This will facilitate comparisons for continuous improvements. Nowadays, most middle managers and project managers may, by and large, choose their own ways of working.

11 Standardize information-management tools

Standardize tools for information management used in construction projects so that they may fulfill growing and increasingly complex data needs. Develop standards that enable existing and future tools to communicate with each other.

12 Plan accurately and follow-up continuously

Make detailed and informed plans (e.g. project plans) with clear milestones, and then follow up continuously. Ban surprises! Detailed plans reduce risks and uncertainties, which leads to reduced waste on several levels.

13 Minimize weather dependency by means of prefabrication and weather-protected assembly

Reduce weather dependence by increasing the

proportion of prefabrication and avoiding the storage of building materials on an open site. Shelter the construction to provide opportunities for assembling in other, more efficient sequences.

14 Establish disciplined information structures and meetings

Consider whether each meeting is necessary? Could it be merged with other meetings? Set a limit on the length of meetings. Will one hour suffice? Plan longer meetings carefully and communicate clearly who should participate at each stage of the meeting.

15 Structure supply flows for efficient assembly

Focus on the most efficient way to move material to the assembly site, and make sure it is there on time. Production will thus become more structured and the processes more orderly.

III Develop the organization and its capabilities

16 Actively support suppliers in their development

For many companies suppliers account for the bulk of the turnover. Actively support the suppliers that are most important to you in terms of volume and/or skills and who have you as their major customer.

17 Select employees with the appropriate skills and attitudes

Your configuration of your organization is extremely important to achieve profitable results. Choose employees with the appropriate skills for the job and who have a desire to further develop their skills and contribute to value-adding processes.

18 Strive for aligned teams and project organizations

Aim to develop and use aligned project teams, both internal teams as well as project teams containing members from external companies, e.g. the design team. An aligned team reduces communication routes as well communication mismatches.

19 Consider new skills to meet new approaches

Knowing where the client's money is spent generates a need for specific skills such as client project management, contractor, production planning, materials supply, as well as the ability to be able to consistently detect what adds value and what does not.

20 Encourage further training

Encourage training that provides opportunities for sharing experiences with others who are in similar work situations or in other areas of knowledge, and that lead to increased understanding of how a combined work effort would best lead to increased customer value.

21 Support the development of individuals' effectiveness

Support employee efforts to increase their personal effectiveness, i.e. to plan the workday, and then follow the plan as closely as possible, to prioritize the most important tasks, to avoid time wasters such as reading new email as soon as it arrives.

22 Plan in reflection and training

Schedule time for reflection and knowledge sharing in ongoing projects to provide opportunities to capture new ideas that could increase work effectiveness. At the end of a project identify and document lessons learned.

IV Discipline management

23 Base management decisions on a long-term philosophy

Create relevant goals that will stand the test of time and survive management changes and economic fluctuations. This will provide stability to the organization and security to the staff. However, making these kind of choices requires strong determination, and courage, from both the owners and the management.

24 Strive for order and neatness in the workplace

Aim for a well organized and tidy workplace. The level of order on the work site dictates the quality

of the work done. A noisy, untidy workplace increases the risk of carelessness, resulting in waste. A clean, well-structured workplace supports employees in their work to achieve greater precision.

25 Give clear instructions, which cannot be misunderstood

Give clear instructions on how work should be carried out and formulate the performance levels that apply. Separate important information from the less important, communicate it in a straightforward manner, and sensitively follow up that the information has been correctly understood.

26 Set high standards that drive development

Set high standards for critical key factors driving change. Set high standards for e.g. energy consumption in new buildings. This will create the need to use new, smarter solutions. Setting high standards for ethical and moral behavior is the utmost importance.

27 Reward good work

Develop a reward system that provides incentives for employees to contribute in every way to the overall goals of the project and the company. One way to achieve this is to make greater use of schemes that reward work that benefits the company's long-term profitability.

V Carry through successive improvements

28 Measure in order to uncover waste

Almost all waste is hidden, or rather, employees do not have the ability to understand what exactly adds customer value and what does not. Therefore, take simple measurements to uncover waste. Follow up how particular resources are used and when value is added to a product.

29 Measure to control improvement work

Develop simple, relevant measurement systems that provide data to guide improvement. First and foremost measure how effectively value is added to the product and, second, determine the factors that influence the levels of effectiveness.

30 Collect and use best practices systematically

Systematically collect the good work methods and the newly acquired experience of each project and use them in subsequent projects. Make sure that these experiences are transferred to both customers and suppliers.

31 Link all improvement initiatives relate to product characteristics or to the value-adding process

Improvement work in itself is not customer value adding. Therefore, any improvement initiative must concern an established change in product characteristics or a known change in the process.

Appendix 2: Identify strengths and weaknesses

Evaluate each recommendation on a scale of 1-10, where 1 means that you do not implement the recommendation, and 10 means that you fully implement the recommendation. Then use the results to evaluate your opportunities for improvement.

Points **Standardize the product from an overall perspective** Points

- Base product definition on running costs over the product's life cycle (1)
- Prioritize sustainability in system choices (2)
- Develop technical solutions that can be used for several products (3)
- Reduce the range of components (4)
- Standardize components (5)

Define and standardize the process

- Define the factual customer requirements (6)
- Oversee that all project members know and understand project goals (7)
- Seek long-term customer-supplier relationships (8)
- Use all of the week's 168 hours (9)
- Develop similar ways of working (10)
- Standardize information-management tools (11)
- Plan accurately and follow up continuously (12)
- Minimize weather dependence by means of prefabricating and weather protected assembly (13)
- Establish disciplined information structures and meetings (14)
- Structure supply flows for efficient assembly (15)

Develop the organization and its capabilities

- Actively support suppliers in their development (16)
- Select employees with the appropriate skills and attitudes (17)
- Strive for aligned teams and project organizations (18)
- Consider new skills to meet new approaches (19)
- Encourage further training (20)
- Support the development of individual effectiveness (21)
- Plan in reflection and training (22)

Discipline management

- Base management decisions on a long-term philosophy (23)
- Strive for order and neatness in the workplace (24)
- Give clear instructions, which cannot be misinterpreted (25)
- Set high demands that drive development (26)
- Reward good work (27)

Carry through successive improvements

- Measure in order to uncover waste (28)
- Measure to control improvement work (29)
- Collect and use best practices systematically (30)
- Link all improvements initiatives to product characteristics or to the value-adding process (31)

This report concerns actions that individuals and organisations could and should take to eliminate waste, i.e. eliminate tasks that are performed but that do not add any value to the customer. By presenting 31 recommendations derived from a series of meetings held with groups of practitioners, the primary purpose is to support and encourage individuals and organisations in their efforts to reduce waste. The report has a wide target audience: politicians, branch representatives, corporate managers, line managers and specialists in nearly all categories of players.



Per-Erik Josephson is Professor of Construction Management at Chalmers University of Technology and former Director of the Centre for Management of the Built Environment. His research is mainly focused on process and resource efficiency in construction. Josephson has published numbers of reports and research papers on defects, waste, leadership and change.



Lasse Björkman (born Saukkoriipi) holds a Master of Science degree in Management of Technology and a Licentiate of Engineering degree in Construction Management at Chalmers University of Technology. He is now working on his doctoral thesis concerning waste in construction.



The Centre for Management of the Built Environment is working for a better leadership within the built environment. Our tools are education, research and debate. Working closely with our industry partners, we are dedicated to improve the Swedish construction sector. Please visit us at www.chalmers.se/cmb for more information!