

Lean and Green integration into production system models – Experiences from Swedish industry

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ABSTRACT

This paper focuses on integration of environmental management and operations management, specifically on incorporation of environmental management into production system models. As a frame of reference, the paper introduces the structure of so called XPS, lean-based improvement programmes in the form of company-specific production systems, as well as the structure and content of environmental management systems (EMS). Studies from two global Swedish companies, where efforts have been made to integrate environmental management into each company's specific production system, are presented and compared with examples from two reference companies and literature. The cases are discussed and suggestions are made for the next steps in system integration and how these could be implemented. It is concluded that XPS and EMS have different scope and purpose, but great opportunities exist in further integration, in order to gain a sustained success of improvement efforts also concerning environmental health and safety (EHS) objectives. Further is there no one right integrated management system; each organization needs to consider its corporate culture and the nature of its operations and business. Still, incorporating EHS management into XPS is seen as an effective way of establishing company commonality in continuous improvements, resulting in holistic understanding and improved organization performance.

Keywords: environment, production system, XPS, EMS, management systems, OHS

1. INTRODUCTION

Formal management systems concerning quality (QMS), environment (EMS) and occupational health and safety (OHS) are today established practices within most manufacturing companies. Meanwhile many companies do develop, codify and copy recipes for how to operate in terms of best practice programmes. These are in many cases tailored into own best-way improvement programmes in the form of models of company-specific production systems (XPS) [1].

However, companies still experience difficulty in integrating the formal management systems with the operational focused production system (XPS). Quality management systems have often been somewhat integrated in the production system models, but there still exists a general gap when it comes to EMS and OHS. While for instance an EMS in accordance with ISO 14001 stipulates to improve environmental performance, but not how this should be organized or what methods to use, the production system or lean programme can promote certain methods, tools and ways to organize the efforts. Thus there is a need of increased knowledge and approaches supporting companies in their attempt of incorporating environmental, health and safety management issues into production system models.

The objective of this paper is to contribute to the knowledge field of sustainable manufacturing by

expanding the analysis of the integration of Environmental management and Operations management. Specifically this paper studies the integration of formal management systems and best practice-oriented improvement programmes for the production system, also called XPS. The purpose is to by examples show challenges, solutions and potential in integrating these two.

2. METHODOLOGY

The paper employs a multiple case study logic focusing the development of the XPS and its integration with the EMS, QMS and OHS at two Swedish companies (Case company A; The Volvo Group and Case company B; Haldex). The two cases are selected on the basis of a theoretical replication where the case studies are expected to produce contrasting results but for predictable reasons [2]. However, the study is still of an explorative nature and the full extent of correlating the two case study findings to the specific case characteristics are not expected in this study. The study is expected to reveal initial patterns in the integration issues in two specific cases, patterns that in following studies can be analysed in detail. Finally the findings of this two-case study are contrasted to two reference companies: a third Swedish company (Company C; Scania) and published work on a Swedish implementation of the Toyota Production System (Company D; Toyota Material Handling). The purpose of this final comparative analysis is to briefly compare the specific contrasting results from the case studies

with two established production system models, often used as benchmarks within the manufacturing industry. The cases and XPS employed are illustrated in Table 1.

The descriptive results lead to discussion of the possibilities for integration of Environmental management systems, QMS and OHS into the XPS. The cases show what the company points out in their descriptions, not necessarily correspondent to what they achieve in all of their operations.

Table 1. Companies and XPS in the study

	Case company A	Case company B	Reference company	
Company	The Volvo Group	Haldex	Scania Company C	Toyota Material Handling Company D
XPS	Volvo Production System (VPS)	The Haldex Way	Scania Production System (SPS)	Toyota Production System (TPS)

The research has used approaches such as literature reviews and interviews together with collected experiences from Master of Science thesis's and other research projects, such as Swedish Production System (SwePS) and Green Production System. The results are contrasted to experiences from practitioner action research at Case company A where one of the researchers performed as practitioner with the integration of workplace Safety & Health and Environmental care into the XPS.

3. PRODUCTION SYSTEM MODELS; XPS

The fundamental of industrial activity is to compete through operational excellence. Over the years researchers and practitioners have defined best practices as a knowledge base for operational transformation and improvement efforts. The lean production paradigm is the most significant example of an effort for defining production practice to be transferred into codified knowledge. As described by Netland (2012), companies have, since the mid-1990s, developed their XPS's, company-specific lean-based improvement programmes in the form of production systems, systematising and adapting the best practices to the company's own unique characteristics and environment, in order to gain a sustained success of improvement efforts [1].

Such a XPS, or production system model, could be seen as an abstraction of the physical production system, including all functions and resources required to design, produce, distribute, and service a manufactured product. It is the conceptual model that maps the production system and the management systems that controls it. However as any map, it should mirror the reality, in this case it should mirror the actual socio- technical system of people, machines and information that creates the products.

3.1. The origin of XPS: Toyota Production System

Toyota presents the Toyota Production System (TPS) as making it possible for employees to optimize quality by continuously improving the processes and eliminate unnecessary losses of natural, human and company related resources. TPS is argued to affect every part of Toyota's organization and contains a common set of values, knowledge and procedures [3].

TPS is often described as a temple based on stability, with just-in-time and Jidoka as pillars and the goal as roof, as illustrated in Figure 1. The temple contains Kaizen as a driver for continuous improvement (CI) of the other parts [4]. Liker [5] complements the picture of the TPS, containing 4 Ps; Philosophy, Processes, People and Problem solving. These are in turns divided into 14 different principles that are vital items in the system. Although Toyota nowadays acknowledges Likers description, their original description mainly contains the implementation drive-forces, the heart of TPS with two main value-principles; Continuous improvement and Respect for people. These contains five cornerstones; Teamwork, Respect, Challenge, Go-and-see and Improve (Kaizen) [6, 7].



Figure 1. The Toyota Production System as a temple with continuous improvement as driver [4]

3.2. Other XPS

It is clear that there are several viewpoints as to what TPS contains, and in a study by Netland (2012) at least 32 principles can be extracted from different authors that describe Toyota Production System [1]. It is thus no surprise that companies that are inspired by Toyota have some different focus in their respective XPS. In a study of 30 companies' XPSs 46 different principles were identified [1], 11 of these are apparent in more than half of the companies in the study; Standardized work, Continuous improvements, Total quality, Pull system, Flow orientation, Value stream focus, Employee involvement, Visualization, Customer focus, Stability and robustness and workplace management (5S etc.). It can be noted that sustainability is not mentioned although one of the 46 principles mentioned by 13 companies is HSE (health, safety and

environment) which may be interpreted as one key sustainability dimension. Vision, culture and values as is emphasized in the Philosophy P by Liker are only apparent in five of the companies. This is notable since the ISO-based management systems all require some kind of policy statement that quality, environment, H&S etc. are important values of the companies.

Although the 'X' varies in the different XPSs, since different companies have different business and different context, the reality is that most companies XPS are fairly similar and often contain more or less the same principles and even values. Netland [1] concludes in the study of 30 XPSs that "XPSs are all largely variants of the same thing when it comes to content." [1]

3.4. XPS content in general

Practitioners describe XPS in different ways [4, 5, 7]; for instance as a lean programme or an improvement system or an instrument enabling success, comprising values, knowledge and procedures. Since there exists no ISO standards of what elements are needed in an XPS, different companies apply these differently. Some of the fundamental elements in an XPS are Values, Vision and principles and usually a set of Methods or Approaches are mentioned as tools to go towards perfection or best practice. Organization and auditing/revision system are other types of elements that are sometimes part of the XPS. Organization and training of the improvement organization into green belts and black belts are especially important in a six sigma type of XPS. In some improvement systems such as "world class manufacturing" and others there has been a stronger focus on the auditing system.

A long term vision based on the companies' core values could be regarded as an essential part for every company that has an XPS. However, as mentioned earlier, in the study by Netland [1], far from all XPS incorporated the aspects of vision, culture and values. The *vision* is a holistic view of the outcome when all the principles and tools come together as an implemented and operational system, aligning along the firm values, further extracted into core principles. The *principles* are often visualized in a temple, as in figure 2, supporting a holistic view, consistency of system thinking and decision making, thus supporting the implementation and daily maintenance of the production system

Further, the principles may be practically implemented through *tools, methods and techniques* focusing material and information flow, driving continuous-improvement activities and behaviours.

In order to revise and improve the implementation, often an *audit or assessment* model is incorporated to score the different units in the company in the different principal areas in order to see a way forward. Also *assessments* are used to compare plants and assess performance levels and assessment approaches has the potential to contribute to organizational learning [6]. In these processes, senior lean experts usually are involved also in the role of supporting to plan the way to

introduce the different tools in order to aim in the visionary direction.

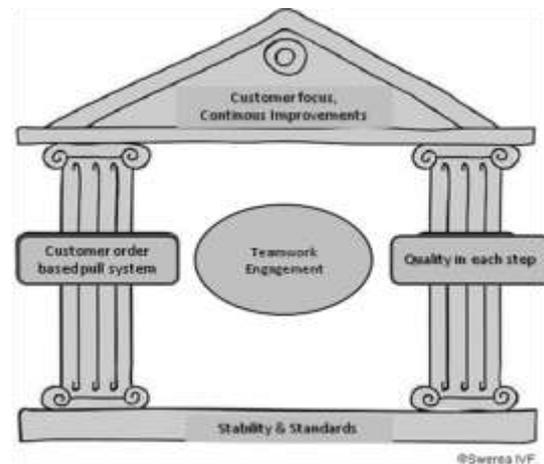


Figure 2. Illustrating principles in a generic XPS [8]

4. MANAGEMENT SYSTEMS, SUCH AS ISO 14001, 9001 OSHAS 18000

During the end of the 1990s most manufacturing companies introduced quality management system based on ISO 9000, shortly followed by systems for the external environment, ISO 14001, and the working environment. OHSAS 18000 is not as old but in some countries, like Sweden, legislation was introduced that could be labelled as pre-runners of OHSAS 18000. Increased awareness and understanding of environmental management have demonstrated relationships with sustainability, competitiveness and operational practice [9] and thus the EMS has become established as mainstream business practice for manufacturing companies. In support of EMS, the ISO 14001 standard as well as a European Eco-Management and Auditing Scheme (EMAS) has been developed in European environmental auditing programs [10].

A survey of all Swedish EMS certified companies in 1998 [11], showed that already at this early age (the first ISO 14001 was released in 1996) coordination of the EMS with the QMS was seen as a key issue in order to increase efficiency. In addition, in Sweden, legislation requiring companies with more than five employees, to implement a working environment system: Systematic Work Environment Management (SAM/AFS 2001:1), increased pressure on all involved parties to coordinate and integrate the different formal management systems. A major issue of the first revision of ISO 14001 was also integration with ISO 9001. As can be seen in figure 3 [12], the requirements of ISO 9001, ISO 14001 and the legislative pre-runner to OHS 18000 look very similar. However, a major difference is that while ISO 9001 stipulates to, e.g. evaluate suppliers and manage core processes like product design and development, ISO 14001 only makes this mandatory if the company's analysis shows that these processes are environmentally significant. Several

researchers [13-15] point to the lack of emphasis on product development in ISO 14001 and in the on-going revision of ISO 14001, “environmental impacts of products and services in the value chain” has been identified as a major challenge [16]. Awaiting the revision, *ISO 14006 Environmental management systems — Guidelines for incorporating ecodesign* [17], can be “used by those organizations that have implemented an EMS in accordance with ISO 14001”....” in integrating ecodesign”. To conclude, while it is almost impossible to implement a quality management system according to ISO 9001 and not integrate it in the company’s core processes, it is possible to implement an EMS that is more or less isolated from core company activities. For that reason, this paper concentrate on EMS integration with XPS.



Figure 3 Similar requirements of ISO 9001, ISO 14001 and Systematic work environment management [12]

In both ISO 9001 and 14001 there is a clear focus on the PDCA cycle although ISO 9001 has less focus on aspects. OHSAS 18001 includes basically the same components as ISO 14001 but with regards to safety. The main difference is that while an EMS handles the environmental aspects the OHS needs to handle health and safety risks[12].

The main objective of all the management systems is to achieve continuous improvement (CI) of the area managed. An EMS in accordance with the requirements of ISO 14001 is a management tool enabling an organization to identify and control the *environmental impact* of its activities, products or services, and to improve its *environmental performance* continually, and to implement a systematic approach to setting *environmental objectives* and targets, to achieving these and to demonstrate the achievements [18], where essentially the same applies to QMS and OHS if environment is exchanged to quality, or health and safety respectively.

4.1. Elements of ISO 14001

As illustrated in figure 4, ISO 14001 emphasizes continuous improvement of environmental performance, based on a Plan-Do-Check-Act (PDCA) cycle.

During the planning phase, the company’s environmental aspects are identified, evaluated and prioritized. Environmental policy and goals are then established based on this information. Note that it is up to the company to decide how to carry out this assessment and thus to decide how and in what way to improve its environmental performance. A minimum requirement is to comply with environmental laws and regulations and to aim for some improvement of performance.

The significant environmental aspects, the legal obligations and the environmental objectives defined in the planning phase are then used in the subsequent implementation phase (Do); for instance when: allocating resources and authority to those with environment related roles and responsibilities; educating the staff broadly and in-depth; modifying operational control procedures; and creating procedures for waste, chemicals, purchasing, product development, transports and emergency situations. What is actually done varies from company to company. ISO 14001 requires “...procedures related to the identified significant environmental aspects of goods and services used by the organization and communicating applicable procedures and requirements to suppliers...”[19].

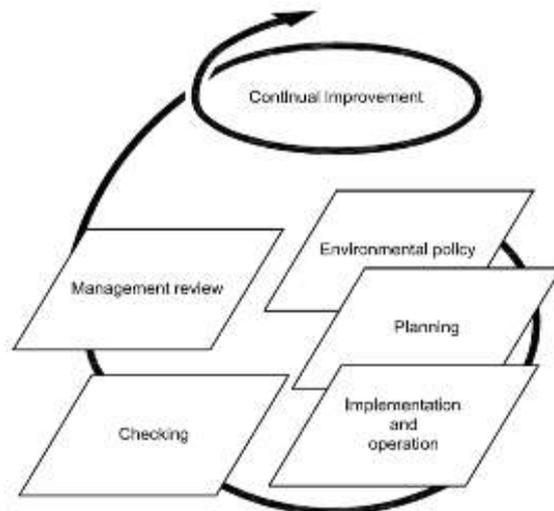


Figure 4. ISO 14001 emphasizes continuous improvement of environmental performance [19]

The Check-phase consists of both regular monitoring and measurement related to the established goals and key operational characteristics. Furthermore periodic auditing that everybody performs according to established procedures and that the system fulfils the requirements of the standard and applicable legal and other requirements is required. In addition, there should be procedures for corrective and preventive actions in cases of non-conformities, to prevent them from happening again.

Management should periodically review the environmental management system and judge its suitability, adequacy and effectiveness. Both the planning and the checking phases provide information for this Act-phase. Verifying that the organization continuously improves its environmental performance is the ultimate objective of the management review.

4.2. Components of an EMS

Certain components are demanded of the EMS in order to comply with the ISO14000 requirements. In short they can be labelled:

1. Environmental aspects
2. Legal requirements
3. Environmental policy
4. Goals and targets
5. Roles and resources e.g. training
6. Operational procedures
7. Monitoring
8. Auditing
9. Procedures for corrective and preventive actions
10. Management review

OHSAS 18001 demands corresponding components of a certified OHS, where environmental aspects are exchanged for occupational health and safety risks and environmental policy is exchanged for health and safety policy [12].

5. INTEGRATION OF EMS AND XPS

The integration of systems can be of two types. One type is to integrate the formal management systems such as QMS, EMS and OHS, which was touched upon in Section 4. Another type is to integrate any of these formal management systems with the XPS of the company. The case studies leading to this paper have emphasised the latter form of integration, with a specific focus on integration of EMS with XPS.

Integration of management systems can be of different level of ambition, Jørgensen et al. (2006) [20] has defined three different levels of integration for management systems: *Correspondent*, where parallel systems correspond to each other; *Coordinated and coherent* has generic processes and combined tasks in the management cycle, and finally *Strategic and inherent* integration where the culture of learning, continuous improvement and stakeholder involvement are integrated.

In order to succeed with integration a clear focus has to lie on the PDCA cycle [21]. The third integration level gives a further requirement to integrate XPS thinking into the integrated management system approach.

5.1. General contributions from XPS and EMS

In general terms, a "traditional" lean program or XPS also has major benefits for environment and workplace safety [22]. Within the visualized picture of the traditional XPS as a lean temple there can be pointed out the "green" spots where lean production give strong benefits to the environmental and workplace safety concerns. However, there are certain blind spots

especially on unnecessary material and energy use, material waste and risk analysis, as illustrated in Figure 5. On the other hand are the ISO-based management systems valuable as tools to identify and improve wasteful activities, especially in combination with lean tools like Value stream mapping (VSM) [23]. Furthermore, the ISO focus on the Plan-Do-Check-Act cycle for continuous improvement ensures staff familiarity [21, 24] with the lean step-by-step improvement mantra.

In addition, the life cycle perspective of environmental work, as manifested in ISO 14006 and in the revision of ISO 14001, challenges the company to extend the improvement work beyond its own gate. Also (chemical) substitution, risk analysis and legal compliance management has been pointed out as areas where EMS can strengthen lean efforts [22].

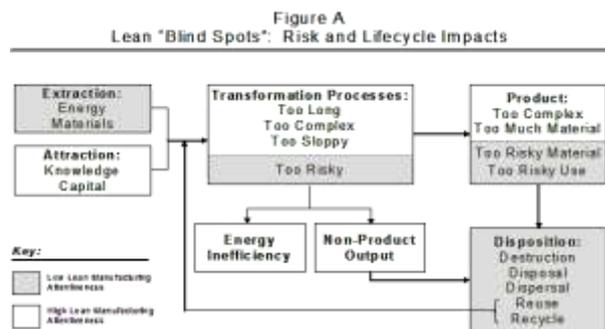


Figure 5. Lean's environmental "blind spots" [22]

Recent studies show that production system development and rationalization approaches have impact on the work organization and workplaces that may lead to both advantages and risks [25]. For instance may the development of production systems contribute to productivity and work enrichment, but has sometimes shown negative impact on physical and psycho-social work environment when there has been a lack of holistic system perspective. Thus, further efforts are needed to integrate also work environment management systems with XPS and EMS.

5.2. Structured comparison between XPS and EMS

Based upon the description and elements of an XPS (described in section 3) and the description and key components of an EMS (section 4), an initial structured comparison between the elements of XPS and components of EMS was made, illustrated in Table 2.

As seen in Table 2, the core of a XPS can include components in line with the demands of an EMS. The issues not included in a clear way in XPS are the legal requirements and a proper identification, evaluation and prioritization of aspects. In OSHAS 18001 this corresponds to risks. The gain of incorporating the systems goes both ways, the EMS (and OHS) will ensure that legal demands risks and aspects are handled in a correct way, and the XPS provides visualized principles with methods and tools to continuously improve these areas.

Table 2. Comparison of XPS and EMS

<u>Components</u>	<u>XPS</u>	<u>EMS</u>
Values	X	X
Visions-Policy	X	XX
Legal requirements		XX
Goal/targets	X	XX
Principles	XX	
Visualisation of principles	X	X
Aspects (Risks in OHS)		XX
Prioritisation	X	XX
Methods & Tools for CI	X	
Operational procedures		XX
CI roles & training	x	XX
Monitoring	x	XX
Audit system	x	XX
Standardised corrective actions		XX
Management CI review	X	XX

XX= compulsory, X= recommended, x=sometimes included

5.3. Possibilities to integrate EMS and XPS

One way to incorporate Safety & Health and Environmental protection could be to re-define “built-in-quality” from merely including the customer value of the product or service. By using a “systems perspective” the term “value added” can be extended to all stakeholders [26], illustrated in figure 6. Shareholders, customers, suppliers, employees and society all have legitimate expectations of an organization. The production process generates different types of value to the different stakeholders. The customer gets a valued product, the employees get work quality and payment, and the owners get reputation and profit. Finally the surrounding society gets an environmental and social impact (and possibly tax revenue).

With a four stakeholder approach applied on the processes means that maintaining quality considers product quality, quality of work, quality of reputation and quality of impact on the surrounding society.



Figure 6. The four stakeholder CI-approach [8]

If a multiple stakeholder approach is applied there will be need for key performance indexes (KPI's) addressing each of the stakeholders, e.g. KPI's for customer quality (Q) and delivery (D) towards the customer, Safety (S) and personal development (P) for employees, environmental performance (E) and legal compliance (L) to the society and cost (C) and return on investment (R) targets towards the owners. Most of

which are somehow incorporated in today's operations anyway. However Jidoka, the pillar addressing quality in figure 1 does not need to be redefined, only reinterpreted into stopping processes not only when the product quality is wrong, but also when safety risks occur, when environmental impact is too high, when there are legal conflicts or when the production is non-profitable. This re-interpretation would not be in conflict with operative personnel's common sense but would demand for re-invention of several of the tools and methods as well as revision of the audit systems.

6. EMPIRICAL STUDY ON INTEGRATION OF ENVIRONMENTAL ASPECTS IN XPS

In order to study the integration of EMS to the XPS, two key case companies have been studied, and contrasted to two reference case companies. The studied companies have introduced EMS into their XPS in similar way, but with some specific characteristics. The presentation starts by an overall description of the XPS at the two case companies.

6.1. XPS at the case companies

Case company A (The Volvo group) has since a long time described idealistic values in the Volvo Way. By creating Volvo Production System (VPS), there has been an increased emphasis on the Volvo Way as a baseline with the three corporate values Safety, Quality and Care for the Environment together with Leadership built on respect. Volvo then builds their production system on a base of teamwork and process stability and other elements similar to Toyota. The visualization is a pyramid instead of a temple, illustrated in figure 7.

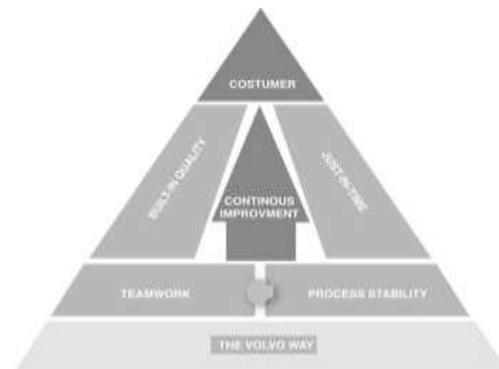


Figure 7. The Volvo Production System (VPS) [27]

At case company B, Haldex, a split of the company with reorganization in 2011 has given changes not covered in this study. The Lean programme that started around 2000 is called The Haldex Way [28]. Their Lean temple and values; Customer First, Respect for the individual and Elimination of Waste-Passion for excellence is very similar to reference company C's Production System (Scania). At Scania and Haldex the XPS are visualized in basically the same way as Toyota with a temple (figure 8), but modified in content. As with Scania the main difference to Volvo is that Environment and safety (as well as quality) are included as priority guidelines and not in the Value statements (However at Scania,

Quality is part of the Values too.) The priority sets Safety/Environment highest, then quality, delivery and finally cost.

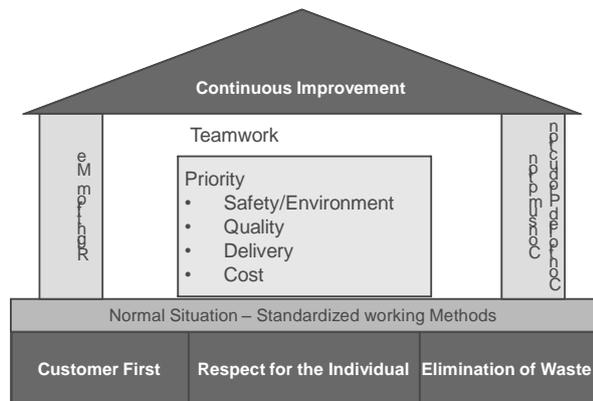


Figure 8. The Haldex Way[28]

The XPS at Scania have similarities with Toyotas TPS, as Scania defines the Scania Production System as a powerful instrument to increase productivity and success [23].

6.2. Integration of environment in the XPS at Company A, Volvo Group

Company A, Volvo Group, has had an environmental management system in place for decades before the implementation of Volvo Production System. Quality and Safety has been mentioned as their Core Values since the beginning and the value of Environmental Care, was introduced in the 1960s [29]. Their management systems (EMS and QMS) are fairly integrated with each other to a coordinated and correspondent level [21] The Core values together with a focus on respect for people have since a long time been described in the Volvo Way.

Volvo's XPS is categorised as a top down integration, from values and downwards. At the introduction of their XPS they from the start tried to incorporate all of their Core Values in their Values and Principles. Built-in-Quality is a pillar in itself in most Lean programmes and was incorporated in the Quality "pillar" (or principle) of the temple. The other principles are Just in Time, Teamwork, Process stability and Continuous Improvement. Two other main elements are the Customer and The Volvo Way, as shown in figure 7. The Volvo Way encompasses Environment and Safety together with Leadership, building the base for the XPS. This gives Environment and Safety a strong base since the values of a company should be in the backbone of everything they do.

Delivery and costs are not any single elements in VPS, instead KPIs for Safety, Quality, Delivery, Cost, Environment and People are followed at Volvo In order to measure the improvements [27]. An assessment and gap analysis points at what CI-tools and techniques can be used in order to improve the KPIs. Netland and Sanchez show that the overall development of

improvement in accordance with VPS-Quality coincides with customer quality measurements [27].

The lean CI-organisation has initially been separate from the organisation for improvements on Environment, Quality and Health & Safety, but the ongoing activities are to integrate these on central as well as local level [29]. Volvo has tried to integrate the ISO-based management system(s) with VPS. This is mainly done as add-on of Environment and Safety as elements in the Volvo way base block. However the ISO-revisions do not audit the VPS model explicitly as of today.

However since the XPS tools are the classic lean tools and not modified, the resulting integration of the company values is not always as strong as the intention was. The original lean tools have gaps, mainly in the areas of safety and environment [21], thus these need further strengthening in the implementation if environmental concerns are to be enough integrated in the XPS [29]. The company has identified a need for further development and integration of lean and green methods [30] and express that it participates in research projects in order to develop new approaches such as E-VSM, energy monitoring, safety visualisation etc. In addition, the ISO 14001 requirements were included in the VPS assessment model as a baseline of the company values.

6.3. Integration of environment in the XPS at Company B, Haldex AB

At, company B (Haldex) the environmental areas are not stated as business values, although the company identified green manufacturing as a possible order winner in the future [31]. On the other hand Health, Safety and Environment (HSE) are given a clearer focus in everyday activities than in company A, and how to prioritise in the improvement work is clearly stated. Haldex could thus be categorised as a bottom up integration of HSE from the operative priorities and upwards.

When it comes to organisation, Company B has a central lean CI-organisation that is connected to the quality organisation. However, the environmental improvement organisation is not connected to the lean and quality organisation and is not as clearly defined as the lean improvement organisation. Still, at one of the two studied sites the responsibility for the tasks end up at the same persons at the ground level [32].

The improvement results at Haldex are measured on basis of three key performance indexes; Delivery, Customer complaints and First Time Pass. Delivery means percentage of production delivered on time, Customer complaints are measured as number of complaints (and cost of complaints) and First Time Pass is the percentage of production that goes through all production processes without needing any rework. All three showed general improvement trends during the years 2006-2009, and the corresponding cost of poor quality improved by 90% at one of the studied plants. Although it cannot be scientifically proven that

the improving trends has anything to do with the XPS or the QMS it is believed that similar trends for environment and work environment could be achieved if KPIs for Environment and Safety would be introduced into the XPS.

A need for development of integrated methods where environmental issues are addressed in the lean methods has been identified at the company [28]. The efforts on Environmental management tools development has been on a similar focus on visualisation and involvement of everyone as in the XPS in order to broaden understanding and involvement of operative personnel.

6.3. Reference company C: Scania

Scania has three core values; Customer First, Respect for the individual and Quality. Although Quality (obviously) and work environment can be identified in these there are no clear environment or social responsibility stated in the values. As driver towards their values Scania points at their production system that states four main principles in their production system [33];

- Normal situation-Standardised working method,
- Consumption controlled production,
- Right from me
- Continuous improvement.

There are four prioritisation guidelines stated in the temple: (1) Safety/Environment, (2) Quality, (3) Delivery and (4) Cost.

This means that Environment and safety comes in at an operative level rather than in the core values. Scania also states in their environmental policy that it is an integrated part of daily work with continuous improvements. Scania can be categorised to have both a bottom up integration of Safety, environment and quality and a top down integration of Quality and some of the health and safety aspects.

6.4. Reference company D: Toyota Material Handling

At Toyota Material Handling in Mjölby, former BT forklifts, the Business Values are said to have an aim to be trusted to be customers first choice and, by quality and innovation, create value in the customers operations, but also to show respect to the society and for the expectations of employees, suppliers and other stakeholders [3].

The Toyota Way is described by the five value principles;

- Challenge,
- Kaizen (Continuous Improvements),
- Genchi Gembutsu (Seek the source leadership and problem solving),
- Respect
- Teamwork

TPS is described in the traditional temple, as in figure 1, but it is notable that both Environment and H&S are stated in the roof of the temple together with quality,

delivery and cost in Mjölby. TPS is further described under five headings; (1) Just-in-time, (2) Jidoka (autonomation), (3) Kaizen (Continuous Improvements) (4) Environment and (5) Health & Safety. Under environment it is specified that TPS includes the 3 Rs: Reduce, Reuse, Recycle. In their business models they also encompass these values since they are promoting new business models where Toyota retains ownership of the forklifts and thus retains a business incentive to optimize the whole life cycle of the products. Toyota in Mjölby are certified in accordance to ISO 9001 and 14001 and their policies are stated on their website

Toyota Material handling is thus categorized as implementing environment, health and safety aspects in a top down integration. In some sense they are touching upon a strategic integration where also business models are integrated to some respect.

6.5. Summarized analysis of EMS and XPS

The XPS characteristics and its integration with EMS aspects, at the case companies, are summarized in Table 3. The companies have different statements of corporate values and Integration of quality (Q), environment (E), occupational health and safety (OHS) in the values and principles is marked in the table. In chapter five we concluded that QMS, EMS and OHS should be fairly easy to integrate with each other (figure 3) and with XPS (table 2). But in the two case companies difficulties have been experienced in succeeding with integration when several different departments are involved. Some Volvo group companies have managed this by organising quality, environment, work environment and lean/CI expertise in the same department in order to facilitate cooperation. None of the companies have reinvented all lean CI-methods and tools to cover all of the Q, E and OHS issues.

Another perceived problem has been too many different types of revisions. With internal, external and regulatory revisions the experts are busier with revisions than with supporting continuous improvements. Therefore integrated revisions are high on the wish list. But that would require external revision companies to be trained in XPS revisions as well as all the management systems revisions. A start is to integrate internal revisions and to perform full internal revisions when either system is externally audited. One key for success stated by both companies is to make KPIs for all targets.

Finally both studied companies express the importance of having KPI's on all important areas although only implemented by Volvo so-far. This could be interpreted as a step towards a multiple stakeholder approach as described in chapter 5.3.

7. DISCUSSION AND CONCLUSIONS

In conclusion, some lean features are beneficial for the EMS when it comes to including operations personnel in improvement work and some EMS features can support lean programmes with a focus on minimising

Table 3. Cross company analysis of XPS and integration with EMS

XPS element	Company A	Company B	Ref company C	Ref company D
Vision & Values	Q, E, OHS	Q	Q, (OHS)	Q, E, OHS
Principles	Q, E, OHS	Q	Q	Q
Organisational integration	Q, E, OHS, CI	Q, CI	(Not investigated)	(Not investigated)
Methods	Not fully integrated	Not fully integrated	Not fully integrated	Not fully integrated
Auditing	Partly integrated in internal audits	Not integrated	(Not investigated)	(Not investigated)
KPIs	S,Q,D,C,E,P	D,Q1,Q2	(Not investigated)	(Not investigated)
EMS integration	Coherent, Top down	Correspondent, Bottom up	(Not fully analysed)	(Not fully analysed)

see 5.3 for abbreviations

risks and resource depletion as well as ensuring legal demands. Differences, like the difference in which sort of waste to focus on, can complement or divide the systems. However, by the analysis it is concluded that in general it is more efficient, overall, to strive for complementation, coordination and integration as opposed to division and isolation.

7.1. Case study conclusion

The studied companies have tried two somewhat different approaches to include environment and safety values into their XPSes, as illustrated in figure 9, one approach where the integration goes from values and downwards and another approach where integration is done at the operative level and upwards.

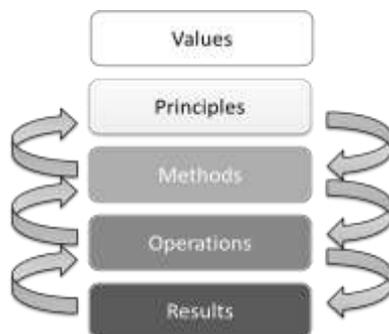


Figure 9. Top down or bottom up approach of integrating environmental aspects in XPS

It seems efficient to have the “green” values included in the values of the company. This is the case in Volvo as well as Toyota. On the other hand clear prioritisation guidelines for the operative personnel as in Haldex and Scania are identified as an important feature. Both approaches struggle with the methods and tools used. If the methods are not adopted for OHS or environment practice challenges it is hard to achieve real operative improvements.

Another issue is that “What is measured gets done” – therefore OHS and environment needs to be part in the Key performance Indicators of the operations and of the improvement organisation, and relevant for both employees and management. If the Results in figure 9 are not measured for environment or OHS parameters it will be hard to engage personnel in efforts and impossible to prove any results.

Finally it seems to be important to recognise the effects on the overall business that environment and occupational health has as is done by Toyota material handling and to some respect Volvo and Scania.

“In order to “walk the talk”, the responsibilities for quality, environment, health and safety and social aspects have to be integrated throughout the organisational culture because of the fact that these responsibilities are inherent in every single aspect of the organisations’ activities from procurement, to product design and production to sale and marketing”[19].

7.2. Future development of incorporation of EMS and work environment systems into XPS

In order to facilitate a full integration of formal management systems into XPS further efforts on integration of tools and methods for continuous improvement are needed.

Also guidelines on how to integrate the description of the XPS in order to fulfill the formal demands of QMS, EMS and OHS are needed together with integrated auditing by auditing bodies.

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