Management accounting in a learning environment

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Abstract

Purpose – The purpose of this paper is to report on the findings of a study designed to understand how management accounting changes when an organization evolves in a more network-oriented direction, informed by an experiential or integrated approach to learning.

Design/methodology/approach – This paper draws on a longitudinal case study initiated by the findings from a previous action research study at a manufacturing plant, the Volvo Floby factory.

Findings – By introducing and elaborating on the concept of local management accounting system (LMAS), this paper contributes to the debate about how management accounting reacts to new organizational forms and technologies. Two types of management accounting information are identified: one corresponds to the accountability aspect of accounting – Type 1 information, while Type 2 information refers to problem solving and control. A LMAS is supportive of both local accountability, which draws on valuing skills, and of local problem solving, which relies on decision skills.

Research limitations/implications – One of the research implications of this study is that a LMAS may function as an important mechanism for innovation by explicitly integrating the holistic and the analytic dimensions of experiential learning.

Practical implications – The reported case illustrates how management accounting may facilitate process innovation in a practical setting.

Originality/value – By adopting an experiential learning methodology to develop new knowledge, the production plant studied has succeeded in creating an environment characterized by continuous innovation.

Keywords Management accounting, Experiential learning, Continuous improvement, Innovation

Paper type Case study

1. Introduction

This paper reports on the results of a case study that investigated the use by line personnel of accounting information in organizational improvement processes. In line with a stream of literature (Simon *et al.*, 1954; Hopwood, 1973; Jönsson, 1992; van der Veeken and Wouters, 2002), line personnel perform management accounting type activities to a large extent as a group. This paper develops the idea that the design of management accounting systems (MAS) and use of management accounting information should change when changes are taking place in the operational environment, along with operational philosophies that govern these changes (Bromwich and Bhimani, 1994; Friedman and Lyne, 1999; Andon *et al.*, 2007).

An interesting debate concerning organizational improvement processes linked to accounting is that between Lukka (1998) and Jönsson (1996, 1998). According to Lukka (1998), there seems to be a widespread understanding that accounting is taking on growing significance because it is one source of the skills that underpin competitive advantage. Given this understanding, Lukka (1998, p. 338) criticizes the view that

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Jönsson (1996) seems to hold that accounting plays only a minor role in the improvement processes. Jönsson (1998) replies that the focus of accounting studies should instead explicitly be set on the communicative aspects of managerial work.

Lukka (1998) raises two interesting points that are relevant to the present paper:

(1) the role of management accountants/controllers in organizational improvement processes; and

(2) given an accounting perspective, what kind of changes MAS may require when an organization engages in organizational improvement processes.

Given the importance of analyzing learning in and from organizational improvement processes, Lukka (1998) perhaps should have questioned Jönsson's (1998) rather restricted and narrow interpretation and use of learning theory. The present paper applies an elaborated analysis based on the experiential learning model of development. With regard to point (1), the role of management accountants in improvement processes, Cooper (1996) suggests that the need for management accounting information will increase while management accountants will have to respond to local information needs (Chenhall and Langfield-Smith, 1998; Johnston *et al.*, 2002). In the reported case, the line personnel are trained in accounting within the system of the competence ladder. When needed, line personnel ask for support from the management accountants who provide them with the needed information, all within some form of a demand-supply system. Concerning point (2), the present paper addresses the question of how management accounting changes when an organization evolves in a more network-oriented direction that is informed by an experiential or integrated approach to learning.

When adopting a philosophy of continuous improvement in manufacturing, management accounting can play an important role as a source of information (Milgrom and Roberts, 1995; Young and Selto, 1993). A lean production system is based, among other things, on empowerment which requires relevant information. As a result, management accounting can be used to enhance employee empowerment and thereby facilitate a learning environment (Fullerton and McWatters, 2002). To serve this purpose, management accounting should adopt additional emphasis on providing more learning-related information.

This paper contributes to the on-going debates concerning how management accounting reacts to new organizational forms and technologies. One need for developing new accounting concepts rests upon changes made in operating activities and new manufacturing concepts. That is, we must understand what is going on in the production environment in order to be able to develop new accounting concepts (Foster and Young, 1997; Bhimani and Roberts, 2004).

This paper uses the term "local management accounting system" (LMAS) to designate MAS designed for and used at a local or operative level. LMAS may be perceived as a new accounting concept directed at gaining efficiency at a local level by the empowerment of employees, and by the diffusion and use of locally designed information. This local efficiency may, for example, be accomplished through continuous experimentation and feedback, using accounting figures.

This paper claims that MAS can be extended by the inclusion of a variety of measures of operational activities in the form of LMAS, along with a knowledge-based incentive system that supports learning and operating efficiency. Thus, the intervening variable between integrative and network-based lean production systems (INLEAPS) and MAS is

a locally designed competence-development scheme, the competence ladder. Empirical evidence is presented in the form of a case study that illustrates how it is possible to empower the employees to experiment and to learn on the basis of feedback.

The remainder of the paper is presented in nine sections. Section 2 explains the research design. Section 3 discusses the theoretical framework. Section 4 gives an account of lean production systems based on the idea of holistic learning while Section 5 describes the competence ladder. Section 6 presents a network-oriented work organization, whereas Section 7 gives an account of modifying local management accounting practices and use. Section 8 provides an analysis and discussion of the results, using the framework developed in Section 3. Concluding remarks are in Section 9.

2. Materials and methods

This paper draws on a longitudinal case study at a manufacturing plant, the Volvo Floby factory. The approach of the research project is typical of Scandinavian research (Lukka, 1998, p. 336) in that it is very empirical and people oriented, it is based on field work and a very large firm plays a significant role as source of empirical material. Berggren (1994) identifies four Swedish contributions to the improvement of work organization and job design, of which one is the integration of fragmented mass production work into holistic tasks, which results in qualitative job enrichment and re-skilling, and thus, empowerment. The present research project draws on this tradition by deliberately using maintenance as a driving force for change in a lean production system, by enhancing the overall capability of learning and by facilitating experimentation.

The Volvo Floby factory was chosen as research site because it has a long standing reputation for being efficient and because both production automation and the design of work organization have reached an advanced stage. Despite the fact that the production technology is advanced, it is still reasonably understandable for someone who has some interest in technology. This circumstance makes it easier to understand the use by, for example, line managers and line personnel of accounting information (van der Veeken and Wouters, 2002). Further, as a subcontractor to the automotive industry, the Volvo Floby factory operates in a very competitive market which requires that cost control has an important role in this plant. Initially, the research project could be characterized as action research with modest intervention (Jönsson, 1996; Adams and McNicholas, 2007; Baker, 2000) in that the research team participated in a collaborative process which aimed to build up work teams that operated in networks. By carrying out experiments and observing the outcomes first-hand, the research team became involved in local learning and continuous improvements efforts. Data, in the form of field notes and formal documents, such as cost accounting reports, production reports, department reports, maintenance reports, budget reports, overhead reports, and meeting minutes, were collected systematically. In addition, the research team had good access to all managers and line personnel. There were feedback presentations of the research findings and frequent discussions with line and plant managers (van der Veeken and Wouters, 2002).

When the project was accepted by the plant management, however, the role of the research team changed, as did the research design, which instead became a case study research design. The aim of case study research is to provide a multi-dimensional picture of the situation (Remenyi *et al.*, 1998). This paper focuses on analyzing the

effects of the implementation of an advanced lean production system, based on holistic, integrative learning of an MAS, and not on the implementation process itself. While an action research phase may take a more concrete, task orientation (Schiller, 1999), a case study may take a more analytical and reflective orientation (Kolb, 1984).

In our case, the findings of the action research initiated a case study. First, the paper describes the transformation from a lean production system based on fragmented or rote learning, to a lean production system based on the idea of holistic learning. Second, by identifying significant events, contingencies, and methods, the connection between holistic learning in a lean production context and a LMAS is analyzed from a pattern-matching perspective (Alasuutari, 1995; Yin, 2002; Flyvbjerg, 2006).

Experiential learning theory serves as the focal analytic tool of the empirical observations for two reasons. First, experiential learning theory is a generic learning theory that covers other, more limited adaptive concepts, such as creativity, problem solving, and decision making (Kolb, 1984, p. 32). In addition, this theory, which is based on a sound theoretical base from which practice can be governed, emphasizes the vital role that experience plays in the learning process.

To be able to conduct a research project in a real-life situation over a long period of time, the researchers must be accepted by those working at the research site. Further, to be accepted, research has to contribute, in this case, to the organizational improvement process. In this situation, the results of the action research project legitimized the case study research. Given the nature of the research site, the fact that the research project lasted for four years supports the validity of the research.

The research project evolved in four consecutive phases: the introductory Phase 1 began in 1989, by using personal interviews to capture the attitudes of production and maintenance personnel towards transferring maintenance tasks from the maintenance department to the shop floor and towards focusing on preventive maintenance (PM) in order to minimize acute maintenance.

In 1990, the experimentation Phase 2 began with the aim to initiate a process of change at the "Brake discs-rear" workshop. In this phase, the research team participated in a collaborative process directed towards building up work teams by means of engaging in local learning and continuous improvement efforts by carrying out experiments and observing the results first-hand.

One year later, in 1991, the entire plant became involved in this organizational improvement process. Phase 3 was called "the whole plant," and lasted until spring 1993. During this phase, our role changed from being the initiators and active participators to that of observers and partners in discussion. In the fall of 1994, an evaluation study, Phase 4, was carried out in order to gain a deeper insight into the driving forces behind the development processes. Phases 1 and 2 are included in the action-research stage, while Phases 3 and 4 make up the case study stage. The research site is located in western Sweden, about 100 kilometres northeast of Gothenburg, in a mostly rural area, and the workforce totals 250. Many of the employees have grown up in this rural area and thus have a deep sense of responsibility and loyalty towards their employer. The Floby plant is still considered to be one of Volvo's most efficient.

3. Theoretical framework

In this section, the relevant literature is reviewed in order to develop a framework for analyzing the empirical observations.

To answer the research question, the paper begins with an elaboration of the distinction between analytic and holistic learning in general, and the experiential learning theory of development in particular. The theory of dual prehension processes, which is briefly reviewed, has gained credibility, partly, due to hemisphere lateralization research. The discussion then focuses on the governance of networks of close personal relationships because this governance plays an important role in INLEAPS. The section is concluded with a discussion of management accounting in a lean production environment. An overview of the theoretical framework is shown in Figure 1.

The theoretical framework is based on the following propositions:

P1. The experiential learning orientation of an organisation and its members is the foundation upon which LMAS (*vis-à-vis* company wide MAS) would emerge and be sustained.

P2. Experiential learning takes place within the production environment and cannot be treated outside it. Therefore, the initial trigger for changing the learning orientation of the organisation comes from the introduction of new production techniques. INLEAPS demand and force the management to initiate a change in the learning style, because the introduction of such a production system places the organisational members into a totally new environment that demands a new style of learning.

P3. Analytical learning is the learning style that supports and underlies traditional accounting systems, whereas holistic learning provides the basis for new accounting concepts. This is because the main focus of traditional accounting

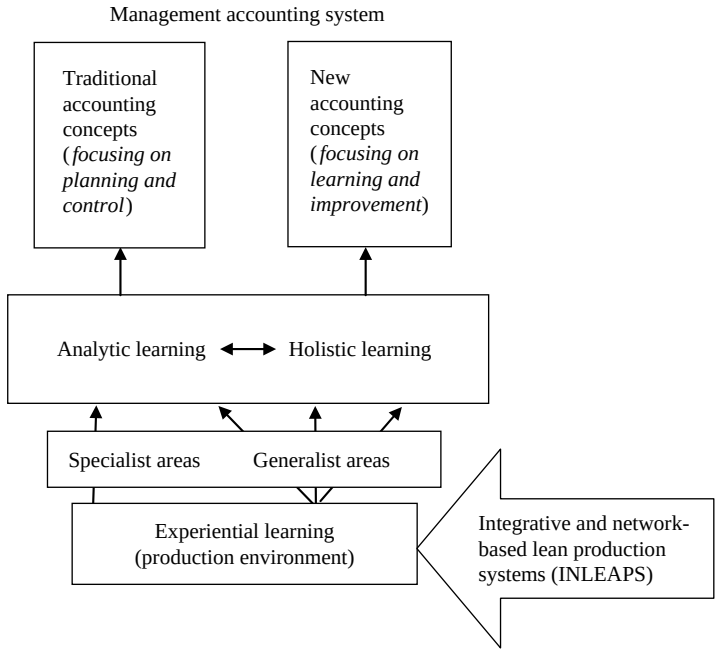

Figure 1.
Overview of the theoretical framework

systems is on planning and control *vis-à-vis* a learning and improvement focus of new techniques.

P4. New accounting concepts are associated with the notion that LMAS facilitates local level learning (experiential learning can effectively be local) whereas traditional accounting concepts are effectively limited to centralised analytical exercises directed towards control of the periphery by the centre.

The dynamic work team (Nonaka, 1991) emerges as the heart of the lean enterprise. As can be seen in Figure 1, the integrative (in terms of knowledge) and network-based lean production system (INLEAPS) affects the learning environment, which is here termed experiential learning (Kolb, 1984). Kolb (1984, p. 38) defines learning as "the process whereby knowledge is created through the transformation of experience."

As previously mentioned, the holistic principle emphasizes the significance of understanding the whole as well as the interrelationships among the elements that make up the whole (Ellegård *et al.*, 1993). In this paper, analytic learning is contrasted with holistic learning. Analytic learning is linked to specialized, articulated, and abstract knowledge and to the related skills of problem identification and complex problem solving within this domain of specialized knowledge (c.f. professional specialization). Nonaka (1991) terms this knowledge "explicit," in that it can be easily communicated and shared. Most people develop a learning style in which some learning abilities take precedence over others (Kolb, 1984, p. 76). Analytic learning may be subdivided into convergent learning and assimilative learning, where the former relies on abstract conceptualization and active experimentation, while the latter depends on abstract conceptualization and reflective observation. The greatest strength of convergent learning relates to problem solving, decision making, and the practical testing of ideas, while the greatest strength of assimilative learning refers to inductive reasoning and the forming of theoretical models (Kolb, 1984, pp. 77-8).

The literature (Kolb and Osland, 1991; Levinthal and March, 1993) maintains that it is practically impossible to learn to do more complex tasks without having supportive formal training. The analytic learner belongs to a formal profession. Kolb (1984, p. 182) maintains that "the emphasis in professions is on controlling the means of performance rather than the outcomes." According to Kolb's view, a person is therefore professionally competent, if he or she performs the accepted professional activities or methods adequately, regardless of the results. In a production environment, one can use analytic knowledge (know-why) within a professional domain, for example within production engineering, production planning, or electrical maintenance.

Holistic learning refers to the production employees' understanding (know-how) of different broad subject areas such as maintenance, programming, quality, local management accounting, and personnel, as well as the interrelationships among these knowledge areas (Smulders, 2004). Holistic learning may be grouped into accommodative learning and divergent learning. Accommodative learning emphasizes concrete experience and active experimentation, whereas divergent learning emphasizes concrete experience and reflective observation (Kolb, 1984, p. 77). The greatest strength of accommodative learning lies in doing things, in carrying out plans and tasks, whereas the greatest strength of divergent learning lies in imaginative ability and awareness of meaning and values (Kolb, 1984, pp. 77-8). In a production design based on holistic learning, the analytic learner has to advance his or her

articulated knowledge, whereas the holistic learner has to widen his or her knowledge in general within a range of subject areas. The difference between analytic learning and holistic learning related to the specific experiential learning environment may be expressed in terms of the learning process: analytic learning is theoretically directed learning-by-doing, whereas holistic learning is practical problem directed learning-by-doing (Sanchez, 1997; Kloot, 1997; Gardner, 1993).

The development of one learning mode precipitates development in others. At higher forms of adaptation, creativity and development clashes between learning modes should be confronted and integrated into a synthesis (Kolb, 1984, p. 31). Nonaka (1991) states that an exchange between tacit and explicit knowledge is an imperative of innovation. Kolb (1984, p. 141) emphasizes that complexity and an integration of dialectic clashes between learning modes are essential for creativity and innovation (Smith *et al.*, 1995; Csikszentmihalyi, 1997). The experiential learning theory of growth and development maintains that by combining elementary forms of learning, higher-order forms will emerge. In this model of development, there are three broad development stages: acquisition, specialization, and integration. There are also three distinct levels of adaptation, which represent consecutively higher-order forms of learning: performance, learning, and development. In the acquisition stage, performance is governed by a registrative process, whereas in the specialization stage, learning is governed by an increasingly interpretative process. At the highest level of development, the integrative stage, a process that is both holistic and development adaptive will emerge.

The theory of dual prehension asserts that there are two distinct, coequal and dialectical ways of knowing about the world. This theory has gained support from research in neurophysiology (Sperry *et al.*, 1969; Bogen, 1969; Levy *et al.*, 1972; Jarvis and Parker, 2005). The brain can be described as being divided into left and right cerebral hemispheres, in which the two maintain a more or less continuous conversation via the *corpus callosum*. Certain adaptive abilities tend to be lateralized to the right or to left cerebral hemisphere. The information processing of the left hemisphere corresponds to the comprehension process – it tends to be abstract, symbolic, analytical, and verbal, while the right hemisphere's information processing, corresponding to the apprehension process, tends to be concrete, spatial, and holistic, and draws together likenesses among different things to enable pattern recognition (Kolb, 1984, p. 48). Levy (1970) proposed the idea that this may be one reason for the evolutionary development of asymmetry in the human brain.

Furthermore, a person's learning orientation affects the development of accounting concepts, ranging from those focusing on planning and control to those focusing on learning and improvement. An example of concepts focusing on planning and control is the traditional standard costing system which discloses variances from standards and which promotes a controlling view. Kaplan and Cooper (1998, p. 57) identify some of the drawbacks of standardized variance calculations, claiming that they are not easily understandable by operators, that they do not promote an integrated process view of the organization, and that they do not directly encourage continuous improvement activities. *Kaizen* and activity-based costings are examples of concepts that focus on learning and improvement, because they provide specific learning and improvement opportunities for those working on the shop floor.

With regard to the governance of networks of close personal relationships, Tomkins (2001, p. 165) states that "if one wants to understand how any relationship works, one

must [. . .] address the boundaries of trust within that relationship." In an insightful study of the links between social structure, decision making, and economic performance within the context of organizational networks, Uzzi (1997) concludes that embedded ties, or close personal relationships, as opposed to arm's-length ties, are made up of three interrelated components:

(1) trust;
(2) fine-grained information; and
(3) joint problem-solving arrangements.

In close personal relationships, trust acts as the principal governance structure, while calculative risk and monitoring systems play a less important role. Trust is expressed as a belief that no one in the relationship will act in self-interest at another's expense. And as such, trust can promote economies of time, allocative efficiency, complex adaptation, and facilitate improvements at no other's expense. Trust is related to the notion of accountability. Fine-grained information transfer – which is more detailed and tacit and which has a holistic structure that is difficult to communicate through arm's length relationships – speeds up the information exchange and decision making. By resolving problems in real time during production, joint-problem-solving arrangements increase the speed at which products are brought to market. Learning and performance feedback and the invention of new solutions make this possible.

Tomkins (2001, p. 185) claims that trust is the principal factor determining the amount and type of information that should be disclosed. He distinguishes between two types of information: one (Type 1) that is needed to create and support continuing trust, and another (Type 2) that is needed for the mastery of events. Over time, both types display an inverse *U*-shape function between trust and information which has implications for the design of lean, up-to-date and cost-effective accounting information systems. Tomkins (2001, p. 185) concludes that no new basic accounting techniques will be required, but that there will be a need for more complex analysis in most areas of accounting. van der Meer-Kooistra and Scapens (2004, p. 17) develop this idea further by suggesting that:

> [. . .] lateral relationships enable organizations to cope with increasing uncertainty by exploiting specific local information, particularly tacit knowledge, through information and knowledge sharing which speed up the decision-making processes.

The traditional forms of management accounting can only play a partial role in the four structures needed to provide for the governance of the relationships that are identified. These four structures, which constitute the minimal structure, are the institutional, the economic, the social and the technical structures.

New accounting concepts related to holistic learning in a lean production environment

Operating procedures and standards are cemented in budget models that describe normalcy, and in management accounting reports that disclose deviations from normalcy. In this context, as Jönsson and Grönlund (1988) point out, learning is experiential but restricted by the conceptual model provided by the budget and other standard setting management tools. The MAS of the employers are traditional, in that they measure activities regularly, objectively, uniformly, and with high precision, using quantitative measurements. In such systems, comparability with other units,

budgets and plans is a key issue. The authors report, however, that foremen at the local level claim that the central system does not provide them with relevant information. The reports come too late and only show which accounts have been overspent and by how much, and give no information about the machine, the product, the event and the party responsible. It is not unusual to have a time lag between the events reported and the accounting report. Furthermore, production personnel need to be able to read the reports, and not just the accountants (Banker *et al.*, 1993; Cobb, 1993).

Hence, central reports communicate that something is (probably) wrong, but do not give suggestions as to what can be done; for that purpose, other sources of information have to be called upon. By contrast, local management reports emphasize five factors over which local teams can exert some control: machine stoppages, consumption of tools, consumption of indirect materials, maintenance, and scrap and rework. Grönlund (1989) indicates that the most important factor is to minimize stoppages, which relates to capital costs. This factor can be achieved by reversing the ratio of preventive and acute maintenance (according to lean thinking) thereby increasing the time the machine is running and producing acceptable parts. PM has become one of the main responsibilities of the operators. This conclusion is consistent with Imai (1998) who maintains that PM and quality management are keys to lean production survival. Obviously, if machines run smoothly, producing high-quality parts on a timely basis and in the volume ordered, all the employees, as well as the management, will benefit. Consequently, the provision of multi-skilled, well-trained, and well-motivated operators is of crucial importance to the survival of any modern production plant.

Local management accounting systems

LMAS can be seen as an extension of the comprehensive information display systems that Womack *et al.* (1997) discuss. In order to support local learning and the development of competent local responses to challenges from the environment as well as from central management, LMAS are based on local rationality. Local control requires *ad hoc* model building and testing in a continuous search for solutions to operational problems (Langfield-Smith, 1997; Mia, 2000). Cause-and-effect chains rather than hierarchies of goal statements are modelled in the local control process. The task of a local manager is to experiment, within the given technical structure, with behavioural rules to achieve improvement (or "best practice"), for example, cost improvement.

The main idea behind LMAS is to facilitate the communication of individual knowledge between people at a local level, and thus enhance the organization's capability for learning (Westin, 1993; Grönlund, 1989; Samuelson, 1990). Furthermore, LMAS, in contrast to traditional management control systems, are based on concrete and experimental information directed at processes. That is, the qualitative characteristics of the local management accounting information may be described in terms such as *ad hoc*, detailed, concrete, unofficial, monetary, physical, and covering different areas.

A LMAS is local in the sense that the term refers to the operating process and this function is essential for systems that produce goods and services in profit, as well as in non-profit, organizations. From a systems approach (Puxty, 1993; Abernethy and Lillis, 1995), management control[1] focuses on people, while operational control is directed at things. The traditional view holds that management control systems are ordinarily designed around a financial structure, whereas operational control data are often non-monetary. Furthermore, most of the information in management control

systems consists of summaries of transactions, for example, production costs for a month or maintenance costs in total, while data in an operational control system is often in real time, that is, it is reported as the event occurs.

A LMAS lies within the realm of the core process in that it focuses on continuous improvement and the dissemination of improvement and innovation efforts at the local level, or in other words, at the first-line level of the managerial hierarchy. But, it is important to stress that the term LMAS emphasizes and is directed exclusively at disclosing the link between the economic and the physical side of any business activity. Furthermore, by using information that is simultaneously expressed in terms of monetary and non-monetary data, an additional common language is established throughout the organization, and thus cross-team as well as cross-border and cross-level learning will be enhanced (Smulders, 2004).

Although the concepts of LMAS and *Kaizen* costing have several characteristics in common, they are distinguished by their different learning foci. Both LMAS and *Kaizen* costing systems are designed to provide direct financial feedback to those working on the shop floor. In order to promote specific learning and continuous improvement activities, their design is based on the actual production processes. From a target-costing point of view, *Kaizen* costing is an extension of target costing into the production environment. Whereas the primary focuses of a *Kaizen* costing system is to reduce an actual cost to below standard cost, the focus of a LMAS is broader in that it also aims to disclose the link between the economic and the physical side of any business activity. In other words, a LMAS takes a more holistic learning approach than does *Kaizen* costing.

Thus, although a LMAS is only one of many tools, it is an efficient means of empowering employees, in that it is an instrument primarily for cost improvement, control, and the following-up of activities. LMAS may also be a beneficial input to cost or budget control systems. The usefulness of LMAS is directly proportional to the increased flattening of the hierarchy[2], and with the degree of focus on holistic, integrative learning.

Traditional management accounting concepts related to a lean production environment

Companies today compete on many dimensions, thereby creating a need for multi-dimensional MAS (Fitzgerald *et al.*, 1991). These systems should include not only measurements of results, but also measures of the determinants of those results. That is, MAS have to monitor both financial measures (for example, cost of quality and scrap cost) and, non-financial measures (for example, setup time, throughput, and machine utilization) (Bromwich and Bhimani, 1989; Swenson and Cassidy, 1993).

Foster and Horngren (1987, 1988) claim that companies adopting a "traditional" lean production philosophy (Hines *et al.*, 2004) are making one or more distinct changes to their cost or MAS. Any cost or MAS should reflect the underlying operations, as well as the organizational structure in which the system is to be used. Accordingly, as indicated in leading textbooks, any significant change in the day-to-day operations is likely to require a corresponding change in the accounting system (Drury, 1996; Kaplan and Norton, 1992; Lynch and Cross, 1991; Fitzgerald *et al.*, 1991; Nanni *et al.*, 1992). A properly designed and implemented performance measurement system is one of the most powerful management tools available for controlling operations and fostering change (Young and Selto, 1993). As some authors point out, however, there is no single blueprint for MAS in a lean environment; instead, there is considerable variation in the

changes made (Hendricks, 1994; Milgrom and Roberts, 1995). But, as they observe, these changes share an underlying commonality which is a movement toward a simplification of cost accounting practices.

In a study of 253 US firms, of which 95 firms have implemented just-in-time (JIT), Fullerton and McWatters (2002, p. 730) concluded that a successful implementation of JIT practices requires complementary decision making and control systems that incorporates bottom-up measures as well as frequent reports of quality results and vendor reliability. Control systems must be supplemented by empowering operators and linking compensation rewards to non-traditional performance measures. More specifically, their statistical tests provide empirical evidence that those firms employing higher levels of JIT practices more frequently use performance measurements related to scrap, rework, machine downtime, and setups (Fullerton and McWatters, 2002, p. 727).

Figure 1 shows how management accounting information can change when holistic, integrated learning is the basis for the implementation of network-oriented lean production systems. The concept of INLEAPS is based on the assumption that the more knowledgeable the employees, the more efficient the operations. The specialists have to become better experts, and the production personnel have to continuously increase their knowledge and improve their skills in different functional areas, and thus, become better generalists. This learning orientation affects the development of accounting concepts, from those focusing on planning and control to those focusing on learning and improvement.

With this frame of reference, the paper reports the findings from a longitudinal case study at a manufacturing plant and illustrates how management accounting information can change when holistic, integrative learning is the basis for the implementation of network-oriented lean production systems.

4. Lean production methods based on the idea of holistic learning

The Floby plant considers the availability rate of the machines to be the crucial indicator of the organization's capacity for learning. This indicator provided the research project with the opportunity to experiment with building a learning environment that is based on holistic learning within a workshop. In a high-profile plant accustomed to improvement projects, the plant management had the courage to undertake projects that radically changed the current work organization. In answer to a direct question about what he considered to be the outlook for this plant-wide change project, the Plant Manager Lennart Almqvist, answered in a typical Floby-manner – "if it does not succeed here at Floby, it will not succeed elsewhere."

Workshop brake discs-rear

The workshop consists of three lines of machines. The first two lines have different turning machines – coarse or rough, intermediary, and fine. The third line produces components for Saab, a competing automobile manufacturer: from now on in this paper, however, we will consider only those lines that manufacture items for Volvo automobiles. The different lines produce different brake discs. At the beginning of each line, a lifter automatically picks up brake discs from a pallet to load the line. The first turn-machines grip a new work piece as soon as the previous one has been delivered to the next operation. The work pieces are moved down the two lines, which then

converge into one line before feeding the drilling station with different holes for different brake discs. Thereafter, the work pieces are moved down to the balancing station, and before they reach the control station, they are stamped. Those work pieces that do not meet the ISO 9001 standard are pushed aside, possibly to be reworked later, while those meeting the standard are moved down the line to the next station, where they are cleaned and protected against corrosion. Finally, after being dried in the drying oven, the work pieces are packed for shipment.

Net sales for the workshop amount to around 10 percent of the total net sales at Volvo Floby, and the variable manufacturing costs – including maintenance costs – amount to 37 percent of the value added. Depreciation accounts for more than 25 percent, while direct labour amounts to 16 percent. Each shift has four operators, of whom two monitor load and shift tools on the two first lines. A third operator handles the drilling machine, the balancing machine, and the stamping equipment, and in addition, surveys the control function, i.e. measuring and inspection. The fourth operator is responsible for the cleaning and corrosion protection facilities, as well as the drying oven and the packing of the finished brake discs into awaiting pallets. Consequently, there are three distinct competence areas in this part of the workshop, something which is also reflected in the ladder of competence and, hence, the operators are paid accordingly. In addition, there is one "setter-up" and "fixer," who primarily carries out mechanical PM measures, and when needed, replaces any operator. A maximum of three shifts can be in place, depending on the market situation. A foreman is accountable for the workshop to the car production manager who, in turn, is accountable to the plant manager.

The transformation – the design phase

The first step in transforming the lean production system from being based on rote learning to being based on holistic learning was taken in 1990. The first year of experimentation involved just one workshop – the brake discs-rear. The focus of the experimentation was on building up the competence of the production personnel, together with initiating and establishing an environment for continuous improvement. By giving PM pre-eminence over acute maintenance, we experimented with how different work practices, modes of organizational design, information support, compensation systems, design of management, etc. can enhance learning, and thus competence.

PM activities require a different type of learning than acute maintenance. The learning logic is more reflective – "what if?", and more holistic – "have we covered all aspects?" By taking advantage of this learning logic, a change process was initiated in the workshop. Towards the end of 1990, the brake discs-rear workshop reported an improvement of 3.6 percentage points in the availability rate – from the already high value of 71.0 percent (of the time the machines are available for manufacturing acceptable products) in 1989. The plant manager was convinced that increased PM was worthwhile, so a program for the entire plant was initiated. Not everyone in the maintenance department, however, agreed that it was worthwhile investing in PM efforts at the expense of acute measures. For example, one maintenance representative attending a PM group meeting stated that fault-detection is the best way of learning: "if there is too much preventive maintenance we might have to send our electricians on courses to practice fault-detection – like they do with pilots [...]."

The transformation – the approval phase

In 1991, after being reviewed and approved by the plant management group, the experiment was extended to include the entire plant. This approval was based on the following assumptions:

(1) Increased availability will lead to lower production costs, which in turn will generate more demand, which will produce larger batches, etc.

(2) Operators are responsible for their machines, as machine managers who see to the welfare of the machines.

The status of the machines will be enhanced by improved knowledge among those responsible for the machines and through these workers, among all personnel.

The 1991 program included the following activities:

- PM groups, responsible for all maintenance, were set up for all workshops.
- PM schedules were designed for all workshops.
- Periodic program for exchange of machine components were established.
- Reorganization of the maintenance department was designed to support the PM program.
- Operators attended different "in-house" courses and gradually assumed more responsibility.
- A wage system based on a "ladder of competence" was designed in order to replace the hourly based system.
- New measures for following-up the maintenance department were introduced.
- The assignment of tasks between production and supporting departments were re-vamped.
- Instruments for following-up the causes of failure were re-emphasized.

By the end of 1991, most of the minor errors had been corrected by continuously improving practices and design, and this correction positively affected the availability rate. This result was indicated by the smoothing of the average availability rate. The trend pointed upwards. Given that the peak of the previous economic upswing occurred in 1989 and that the subsequent downswing came about 1992, this trend was even more evident in that the overall activity level changed accordingly. As a result, organizational learning had increased: extensive documentation was made, a competence ladder and PM schedules were designed, and alterations were made in management accounting reports.

The balance between acute and PM can indicate a learning focus, in which the latter type of maintenance emphasizes holistic learning in contrast to the former, which represents acute. There is a break in the 1992 trend from an 80-20 ratio – 80 percent of the time devoted to acute and 20 percent to PM – to a rate around 45-55 during the period 1992-1994.

The transformation – the enforcement phase

By the beginning of 1993, the project had demonstrated its benefits. New standards, norms, values, and structures had been established (Schiller, 1999). Eight key determinants or competencies of success – expressed in terms of machine

availability – were identified. In addition to the more "hard" competencies of attaining and handling high quality, handling flexibility and complexity, and maintaining and handling the machinery, three more "soft" competencies – access to financial- and non-financial information, communication, and social ability – were also identified.

The importance of the three "soft" competencies seemed to increase with the degree of empowerment of the lower level employees. The competencies of handling flexibility, handling complexity, handling quality, and maintaining and handling the machinery are more contextual factors. These context-dependent competencies follow from specialist learning or a technical interpretation of the lean production concept, while the empowerment-dependent competencies relate to a holistic learning interpretation. The two types of competence – context-dependent and empowerment-dependent – may be perceived as two dimensions of lean production. How these two dimensions are interrelated in the particular case determines the learning, and hence, the development foci.

5. The intervening variable – the competence ladder

In a situation where empowerment-dependent competencies are recognized as important, it is possible to design a career path for each individual employee (Karlsson and Åhlström, 1995). Fullerton and McWatters (2002, p. 724) have empirically identified an associational link between JIT practices and rewards for enhancing product quality, throughput times, and team performance. In the Floby case, a competence ladder, in terms of learning requirements, describes the career paths that are open to employees at the workshops. This specially designed competence ladder for each workshop largely replaced the traditional reward system, which is in line with the assumption held by the management at Floby that the more knowledgeable the employees are, the more efficient the operations. As previously pointed out, specialists have to become better specialists, and generalists, or the production personnel have to continuously enlarge their knowledge and skills in different subject areas. The entire structure of subject areas is connected through the introduction of a compensation system based on a "ladder of competence." Examples of subject areas other than PM are materials handling, local management accounting, production planning, and numerical controlled-PC (NC-PC) programming. The competence ladder is linked both to formal training and to experience through job rotation. When introduced, the competence ladder was favourably received by most of the operators. To the operators, the most interesting subject seemed to be NC-PC programming, closely followed by local management accounting and quality. Ulf Lindström, who was appointed coordinator of the local PM group, says that attending courses is stimulating – "one gets the opportunity to try out new things, and the job becomes much more interesting."

From the perspective of individual operators, the competence ladder defines his or her career path, while at the same time this ladder is an instrument of planning for the foreman who has to match the required competence profile – what is needed – with the actual level of competence within the workshop. That local management accounting is related to INLEAPS by the means of a competence ladder will be evident from the discussion and analysis in the following sections. This competence ladder may be perceived as a shop floor curriculum.

6. Network-oriented work organization

In order to constantly improve efficiency and effectiveness, competence and experiential learning became explicit tools of local management. To facilitate knowledge transfer, the work organization had to be redesigned from hierarchical to network oriented. A compressed hierarchy implies empowered work teams that constitute the core around which everything in the production activity revolves, and the support departments have to adjust accordingly. By making the operators responsible for the machines, they became empowered to order specialist jobs from the support departments. The idea is that production personnel in general, and operators in particular, are placed at centre stage in a manner that was prevalent during the era of craft production. This idea is based on the assumption that the more knowledgeable the employees are, the more efficient the operations. Accordingly, the specialists have to become better experts, and the generalists have to continuously extend their knowledge and skills in different functional areas.

Everything is tied together through the introduction of a compensation system based on a "ladder of competence." Taking the workshop "Brake discs-rear" as an example of how the network-oriented work organization works, the interfaces with support or indirect departments were set up according to how questions about who should do what, how and when were answered. Thus, the institutional structure (van der Meer-Kooistra and Scapens, 2004, p. 17) is decided not only by the plant management, but also by the parties in the individual network through negotiations (Tomkins, 2001). One important issue that concerns efficiency and effectiveness has to do with how and to what extent the support departments contribute to the production. In order to increase the visibility and measurability of the performance and efficiency of the support departments, new follow-up measurements were designed. High measures of availability, value-added, and PM are given priority, at the expense of ordinary maintenance costs, for example. These measurements may be referred to as the economic structure.

The social structure, which includes trust and integrity, van der Meer-Kooistra and Scapens (2004) seem to be a key structure at the shop floor level. By forming networks that include people from support departments and work-teams from the workshops, communication was encouraged and strengthened, as was also the case of PM groups. This improved communication had an instant and direct bearing on the availability rate, in that problem identification and problem solving became much more efficient.

The importance of trust can be illustrated by how the measurement-availability rate (Jinhua and Olsson, 2002) was affected by the changeover to a new foreman at the workshop "Brake discs-rear" in 1993. The former foreman could not devote enough time to the workshop. This resulted in too great a distance between him and the line operators.

Examining Figure 2, it can be seen that there was a downward trend in performance during the autumn of 1992, and that around the turn of the year, the trend started to shift upwards.

The seven-week PM overhauls, coded "PM," account for the major part of the low-performance rate during the indicated weeks. We can observe that a steady increase in the performance indicator occurs during the subsequent period or periods after the regular stoppages. The new foreman set about his new task by establishing a close contact with each operator that was based on mutual respect. In his opinion,

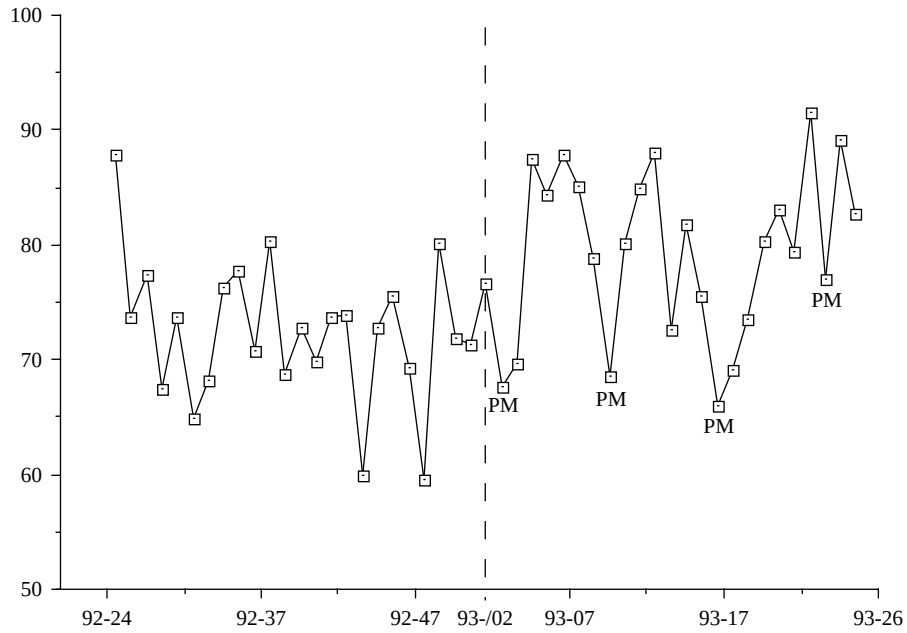

Figure 2.
Changes in the availability rate from week 24, 1992 to week 26, 1993

to enhance the operators' competence it is important to support them and let the operators test different solutions, even if he knows beforehand that these will not work.

As to the technical structure at the workshop level, competence – the ability to apply skills and learn in a production improvement situation – becomes more valuable and worthy of reward. The gap between the actual level of competence and what it ought to be has to be filled by training and formal education. The LMAS forms an important part of the technical structure in that the production personnel are, for example, given bottom-up problem solving information in order to continuously improve machine availability. The different structures reinforce each other and together constitute the framework within which the LMAS works.

7. Modification of local management accounting practices and use

In 1988, the responsibility for the MAS was delegated to the local production units; and in 1989, an internal pricing system was put into operation at Floby. In an attempt to create uniform principles for accounting and costing within the Volvo group, the accounting system was built on a standard chart of accounts from 1953, called the V-chart[3]. The chart of accounts reflects the production process and forms the basis for calculating the operating income, and variances from standard costs. As a measurement of capacity, normal volume, which sets the level of "normal" capacity to 90 percent of the practical capacity, is used.

Different cost drivers or allocation bases, such as value-added and number of units produced, are employed. The accounting department at Floby is accountable for the formal budgeting and accounting systems, as well as for any pre-system, and for the measurements and procedures that accompany these systems. One may say that

the accounting function itself was decentralized in 1988, while the formal accounting system remained centralized. By transferring the responsibility for the MAS to the local units, the reliability and timeliness of the reported figures have increased. Additionally, the content of the reports has been adapted to the needs of those working in the production setting.

Local management accounting – a method for disseminating an "economic way of thinking"

One foreman at the heavy truck section started to experiment with using economic figures for continuous improvement efforts in the 1980s. How these experiments were conducted has been described by Grönlund (1989) – the main mode of operation of the teams: focus on one problem at a time, take action, determine whether costs have improved, refocus on another problem. As Grönlund argues, this way of experimenting brings about learning that is continuously built into the standard operating procedures of the teams, and hence, provides the MAS with adjusted standard prices and quantities.

The most successful episodes described by Grönlund (1989) originated from the team that runs the shaft-line in what they call the A-ville plant; that is, the Floby plant. However, the idea of local management accounting did not spread throughout the plant until local management accounting was included as a distinct subject in those competence ladders that were designed as a result of the plant-wide organizational learning and continuous improvement project, which was initiated 1991. Until that time, local management accounting had been conducted in isolation, and had no influence whatsoever on any other manager or department.

The idea of local management accounting as a subject that is included in the competence ladders of various departments means that all production personnel require some practical and theoretical training in local management accounting, because the competence ladder is linked to the incentive system. Furthermore, continuous improvement efforts, of which local management accounting is one, are coupled to a suggestions system. The aim of this system is to receive one suggestion from each employee each year. This can be considered a quite modest target compared to Japanese counterparts. One consequence of adopting local management accounting as a tool for enhancing learning and reducing costs is that production personnel have started to consider a cost dimension as part of the day-to-day operations (March and Simon, 1993). The production personnel check the accuracy of accounting figures, relate the cost figures to physical output, and try to figure out better ways of doing things. This emphasis includes extensive discussions with colleagues, industrial accountants, production engineers, suppliers of machine tools, and others.

One example of adopting local management accounting is that a foreman, along with some colleagues, discovered a method for renovating, at minimal cost, a tool that is used frequently in the production process. The plant benefited greatly from this cost improvement idea. The inventors would not have had this idea without the knowledge they had gained from the LMAS. Another example was that operators were using too many protective gloves until the foreman told them how much a pair of gloves costs the company. As a result, the consumption of protective gloves fell considerably. Another consequence of training the employees in applying economic thinking, is that they better understand the significance of differences in the economic result of the

company, and hence they become more sensitive to appeals for continuous improvements. Furthermore, by knowing about local management accounting, it is easier for production, as well as supporting personnel, to communicate with people from the accounting department and by extension, such knowledge facilities planning, co-ordination, problem-solving, and following-up.

Local management accounting reports

By downloading data from the central MAS to a LMAS on a PC, the industrial accountants at Floby distribute a budget control report every two weeks to those responsible for production and support functions. The "official" report is disseminated seven days after the end of the month. The foremen appreciate this kind of report, which is timely and is easy to read. The report compares actual results with budgeted amounts on factory overheads, subdivided into three measurements: depreciation, interest, and other items. The first two refer to fixed costs and the last one to variable-overhead costs, i.e. to controllable items. The recipients of this management-by-exception report can easily detect any deviations from expectations. This local management accounting report gives the receiver of the report an opportunity to react in time and to take action to ensure that resources are used efficiently. The capacity utilization rate is now followed up every week as it gives information about the capability for earning profit. Reports about rejects are currently timelier, as they are compiled and distributed every week. The report on inventory of goods processed is disclosed in much more detail than before, and, hence it is easier to trace slack resources to inventories.

Before 1988, the accounting department distributed a report on the efficiency variance for direct labour; that is, the difference between standard direct-labour hours allowed for actual output and actual direct-labour hours. The production personnel had problems with interpreting the calculated variances, and therefore the report was abandoned (McNair *et al.*, 1988; Turney and Anderson, 1989). Now, however, the economic outcome for the Floby plant is discussed every month in an internal information paper that is distributed to all employees. Furthermore, in addition to data about the everyday operations, i.e. "charts on the wall" on which line personnel record real-time non-financial process data, accounting measurements in totals are now posted in a typically Japanese way on information boards in the factory.

8. Discussion and analysis

The nature of local management accounting information

The case presented in this paper supports the claim made by van der Meer-Kooistra and Scapens (2004, p. 18) that management accounting information in lateral relationships is needed to facilitate communication, joint decision making, information sharing, and building trust among parties in networks. The paper addresses the question of how management accounting information can change when holistic learning is the basis for the implementation of network-oriented lean production systems. In answering that question, the concepts of control, and also the type of information are important. Virtually, all firms involve a mixture of arm's length relationships and close personal relationships, of which the former are based on market-like transactions and the latter related to a high level of trust. According to Uzzi (1997, p. 59), close personal relationships enrich the network, while arm's length relationships keep the network in line with market demands and new possibilities. Some authors argue that the higher the

level of trust among the parties, the lower the need for formal control and information, and vice versa (Uzzi, 1997; Tomkins, 2001). This argument explains, at least partly, why in some instances, network structures are efficient in an economic sense. Tomkins (2001, p. 165) argues that "the state of trust at any time is *the* fundamental determinant of information requirements." In a seminal work by Ijiri (1975, p. 47), the author maintains that wealth creation is based on a network of accountability; and that "the function of this network depends upon a smooth flow of accountability information". Furthermore, Ijiri (1975, p. 32) asserts that accountability is what distinguishes accounting from other information systems.

Applying these ideas to the Floby case: in order to check up on the maintenance department (the accountor), the workshop "Brake discs-rear" (the accountee), kept a close record, for example, of how many hours staff from the maintenance department actually spent performing maintenance tasks at the workshop as well as on the costs incurred. This record was later in great detail compared with the number of hours charged and the related cost. This type of local management accounting information (Type 1) relates to the willingness to rely on those factors that are needed to create trust (Tomkins, 2001, p. 171) and check the state of the relationship between parties in a local network (local accountability).

Type 2 information, on the other hand, is needed for "mastery of events"; that is for coordinating activities and joint problem solving. Across-function groups, like the PM group, are important joint decision-making groups that make use of local financial and operational information. Information for detecting the causal linkages between maintenance measures and the effects thereof, the effect of quality work and further training on the availability rate, etc. requires Type 2 information. How different PM measures affect the availability of different machines in operational and financial ways are examples of Type 2 information that triggers experiments in across-function groups. The effects of cutting inventories and lead times at a workshop level are other examples. The improvements initiative may or may not come from the plant management level.

Compared to management accounting information at an arm's length distance, local management accounting information is more detailed, includes more non-financial measurements and is more holistic, in that it may consider several interrelated aspects (Uzzi, 1997). Local management accounting information of Type 1 may be somewhat more simplified and more regular compared to Type 2, in that the main objective of Type 1 information is to support trust, with trust being an alternative to information (Tomkins, 2001). Trust may change and thereby alter the need for Type 1 information. Both types of management accounting information, based on arm's length logic, and local management accounting information imbued by local logic, are complementary, and information flows back and forth between the two systems. Both systems are also both based on complementary control mechanisms. Adjustments in the MAS which allow for monitoring operators' maintenance work (Type 1 information based on an arm's length logic) is one example of how Type 2 local management accounting information triggers changes in the MAS. Another example is the design of an overall availability rate performance measurement triggered by Type 2 local accounting information. Through the introduction of a "competence ladder," the operators are trained to participate actively in problem identification and problem solving and thus, in joint decision making, information sharing, and building trust between parties

in networks. Thus, local management accounting information may consist of both Type 1 and 2 information, but with an emphasis on the latter.

The experiential theory perspective emphasizes the central role that experience plays in the learning process, and identifies four elementary forms of learning, and thus of knowledge: accommodation, assimilation, convergence, and divergence. Higher-order forms of learning emerge from combinations of these elementary forms, in which the elementary learning processes are the primary means for differentiation of experience. Type 1 information (local accountability information), calls attention to being aware of meaning and values (valuing skills, or divergent knowledge), and to acting skillfully (accommodative knowledge) when exacting accountability from the maintenance department (Figure 3).

Type 1 information compares budgeted or forecasted figures with actual Figures (experience), identifies deviations from budgeted Figures (perception), and exacts accountability (behaviour). Type 2 information (coordination and joint problem solving information), is used to compare pre-calculated costing figures with actual Figures (experience), identify deviations or problems (perception), select a problem (cognition), consider alternative solutions (cognition), evaluate consequences of solutions (cognition), select a solution (cognition), and execute the solution (behaviour).

Thus, both Type 1 and 2 information are initiated from concrete experience, that is to say that they set out from a holistic learning perspective but take different routes through the process of experiential learning. While Type 1 information triggers divergent learning and accommodative learning, that is, it stays within the realm of holistic learning, Type 2 information involves additional learning in the form of assimilative and convergent learning. Consequently, Type 2 information requires both holistic and analytic learning. Type 2 information precipitates the resolution of dialectic conflicts among the different learning modes in an integrated way. This will result in creativity, innovation and growth.

The experiential theory of growth and development asserts that more powerful and adaptive forms of learning emerge when elementary forms of learning are combined and integrated into a creative synthesis. The integration mechanism is crucial in this respect. In nature, the *corpus callosum* is the main integration facilitator, while in a local management accounting context, a blend of integration mechanisms has to play this role, for example, the local management, across-function groups, and the

	Type 1 information	*Type 2 information*
Local logic	Close follow-up of support department activities-accountability information	Across-function problem identification and problem solving information control information
Arm's length logic	Budget versus actual extended chart of accounts	Availability rate performance measurements

Figure 3.
Examples of information that may be included in management accounting (based on arm's length logic) and in local management accounting (based on local logic)

competence ladder. Smulders (2004, p. 263) suggests that integration will be facilitated by providing internships together with adequate in-house training.

There are three levels or structures of information processing: registrative, interpretative, and integrative. On the first level, the registrative, learning takes the form of performance governed by a simple registrative first-order feedback. Thus, as a first step in its development, the LMAS has to be designed, implemented, and used. The information registered by LMAS can be described in terms such as *ad hoc*, detailed, concrete, unofficial, monetary, physical, and covering different areas. The second level is associated with the combination of two elementary learning forms, which creates an evaluative process that serves to define and shape the flow of experience. The interpretative level is primarily analytic, and, hence, relates mainly to Type 2 information. In this case, it is important that the design of the competence ladder is articulated in such a way that it supports interpretation of complex and ill-structured information. The integrative level represents the highest learning level, and it results from a combination and development of the elementary forms of learning. For example, when individuals within an organization experience a problem situation, inquire into it and eventually come up with a workable solution, then integrative learning has probably taken place. It is conceivable that the competence ladder has to include different techniques and methodologies such as cost-benefit, production and logistics, in order to facilitate integrative learning in a production environment.

9. Conclusion

This paper reports how management accounting can change when the work organization transforms into a more network-oriented direction, informed by holistic, integrated learning. Setting out from a regular lean production platform, a system for enhancing the knowledge of operators at the workshop level was implemented together with a network-oriented form of work organization. A consistent emphasis is put on developing the learning environment, complemented by designing supporting information systems within the context of a network-oriented work organization in which the operators are the "chiefs of the machines." A locally designed competence-development scheme, the competence ladder, is designed to shore up learning.

What stands out in the Floby case is an explicit attempt to implement the natural design for learning and development in the local production setting, by organizing an integrative learning environment based on lateralized learning. The integration mechanism, the "*corpus callosum*," consists of the running schedules, the local management, etc. of the competence ladder, in addition to the production layout.

The present paper develops a view of knowledge creation by analyzing the Floby case from an experiential learning theory perspective. This theory has gained great credibility, particularly due to research in neurophysiology, which provides evidence for the theory that there are two different, coequal and dialectically opposed ways of knowing about the world (Kolb, 1984, p. 49). This paper refers to these opposing ways of understanding the world by using the terms "holistic" and "analytic" learning. By integrating different forms of learning, higher-order learning will result.

The paper reports evidence of learning. Given that the availability rate is considered to be the critical indicator of the Volvo plant's capability of learning, this indicator suggests that LMAS supports learning efforts. Local management accounting information, which is more concrete, includes non-financial measurements and is also

more holistic in that it takes account of several interrelated aspects, and is one articulated mechanism for learning. Two types of management accounting information are identified, one of which relates to the accountability aspect of accounting – Type 1 information. Type 2 information, on the other hand, refers to problem solving and control. LMAS is integrated with the MAS in that information flows back and forth between the two systems. This complementary aspect can support integrative learning, and, hence, growth and development (Kolb, 1984). Local Type 1 information (local accountability) is somewhat more simplified and comes regularly compared to local Type 2 information (local problem solving and control) and can support second order learning. Since local Type 2 information is supportive of additional modes of learning, this form of information may uphold higher-order learning. Hence, Type 2 information is more accommodative of integrative learning than Type 1 information. LMAS is idiosyncratic because it is an important knowledge-creating system that facilitates integration between different learning modes and thus supports continuous innovation in a production setting by explicitly integrating the holistic (concrete) and analytic (abstract) dimensions of experiential learning. However, although the empirical findings identify two types of management accounting information within the case study, a full investigation and explanation of such a management accounting information is an area of future research.

Notes

1. Hofstede (1981, p. 193) provides a useful definition of management control by defining it as "a pragmatic concern for results, obtained through people."
2. Senge (1990) who maintains that the old model, "the top thinks and the local acts," must give way to integrated thinking and acting at all levels.
3. The V-chart is similar to the well-known standard chart of accounts of the Swedish Association of Metalworking Industries (*M*-chart).

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