ABSTRACT

Management accounting is an applied science, the idea of which is to produce theoretically grounded solutions for practical purposes. However, the general opinion among management accounting researchers seems to be that management accounting research has failed to produce theories with such pragmatic implications. In addition, there seems to be disagreement in the academic community regarding what practically relevant management accounting research is and how such research should be conducted. Interventionist research has been considered one way to increase the practical relevancy of management accounting research. The objective of this paper is to point out some challenges encountered when trying to pursue practically relevant management accounting research in cooperation with a company manufacturing hydraulic power units. In that research project, the objective was to improve the cost efficiency of the power unit business using mass customization.

In interventionist real-life studies, management accounting researchers might not be able to restrict themselves to management-accounting-related issues. Rather, the researchers might have to be engaged in the change process more holistically, which then causes diseconomies in the creation of a scientific contribution in the field of management accounting. On the other hand, these non-accounting-related tasks enable deeper understanding of the case context and might actually open up new ideas and, thus, can become a significant asset despite the rather boring or uninteresting first impression. Furthermore, decision-makers using the information primarily define what could be considered practically relevant management accounting research and these decision-makers are likely to be found in other functions than the financial department, which means that management accounting researchers should seek more active involvement in other functions as well. This, again, might lead to increased significance of non-accounting-related interventions in an accounting study.

INTRODUCTION

Management accounting is an applied science (Kasanen et al. 1993), the idea of which is to produce theoretically grounded solutions for practical purposes (Mattessich 1995; see also Labro and Tuomela 2003). However, the general opinion among management accounting researchers seems to be that management accounting research has failed to produce theories with such pragmatic implications (see e.g. Hopwood 1983; Kaplan 1984, 1986; Johnson and Kaplan 1987; Hambrick and Fredrickson 2001; Reiter and Williams 2002; Inanga and Schneider 2005). Some discussion on the means to increase the relevance of management accounting can be found in the literature (see e.g. Kaplan 1984, 1986; Zimmerman 2001; Inanga and Schneider 2005; Malmi and Granlund 2006), but the users of the research results in organizations are often bypassed by stating that the research should be relevant to, for example, external users (Malmi and Granlund 2006), actors in organizations (Ahrens and Dent 1998) or practitioners (Ahrens and Dent 1998). However, the users of the results play a significant role in determining what research approach should be used, how the objectives of the study should be set, what role accounting should have in different stages of the research process and what kind of theoretical contribution can be achieved in the study. These
topics, on the other hand, would enable more extensive discussion on the challenges of conducting and publishing practically relevant management accounting research.

The objective of this paper is to point out some challenges encountered in practice when trying to pursue practically relevant management accounting research. The paper is based on an interventionist research project conducted in cooperation with a wholesaler of hydraulic components who also manufactures hydraulic power units. The objective of the research project was to improve the cost efficiency of the power unit business by using mass-customization. Following the ideas of interventionist research, the researchers have participated actively both in technical development work and improvement of cost reporting practices. In early stages of the research project, the level of cost awareness was found to be quite poor and in order to enable the cost effects of mass customization to be analyzed, some improvements in cost reporting practices were needed. However, the cost effects of mass customization were not in the interest of the decision-makers at that time since it was not clear what mass customization would actually mean and how it should be implemented in that context. Thus, in addition to the involvement in cost reporting, significant research efforts were also needed in developing appropriate technical solutions for mass customization. After three years of intensive research cooperation, concepts for mass customized power units now exist and currently the first power units with the new mass-customized solutions are being assembled. According to the preliminary cost estimates, the new solutions are likely to enable cost savings of over 10 per cent, which is a significant cost reduction in a mature industry. Thanks to the academically uninteresting development of cost reporting practices, it will be possible to gather cost data and analyse the cost effects of mass customization in the future. However, the ramp up stage will have its own challenges and learning curve effects, and it might take a year or even two before the final cost effects of the mass-customized solutions can be seen in cost reports.

In this research project, the interventionist role of the researchers points out some interesting issues from the management accounting research point of view. First, if accountants and controllers are to constitute an internal service function, what are the groups of non-accounting people relevant to business to whom the accounting information should be of assistance and are their cost information needs different from those of accountants themselves? In other words, if the accounting information is mainly used by non-accountants, what actually is and who should define pragmatically relevant accounting research? Second, if the main target groups for accounting information are located outside the financial department, what should be the role of accounting in a study considered relevant by accounting scholars? For example, forming an understanding of the accounting context may require lots of work which is possibly unrelated to accounting itself. Third, in an interventionist study, researchers might have to be involved in processes that are relevant from the point of view of the intervention itself, but not necessarily interesting from the academic community point of view. Such being the case, how can the productivity of the researcher and the potential for publication of such an interventionist study be increased?

INTERVENTION FOR INCREASING PRACTICAL RELEVANCY

Many reasons for the failure of management accounting research to produce practically relevant theories have been suggested, such as the dividing of accounting professionals into practitioners and academics (see e.g. Bricker and Previts 1990), the basing of management accounting research mainly on economics (see e.g. Kaplan 1984; Reiter and Williams 2002), the lack of questioning of assumptions based on economics (see e.g. Hopper and Powell 1985), the difficulty of publishing non-economics-based studies due to the control of publishing by an academic elite, especially in
American journals (Lee 1997; Lee 1999; Lee and Williams 1999) and the attempt of management accounting research to imitate the hard sciences (see e.g. Inanga and Schneider 2005). At the beginning of the 1980s, case studies and field research were seen as a solution to at least some of these problems (Kaplan 1984, 1986). However, although field research gained popularity in the 1980s (Ferreira and Merchant 1992), management accounting research has still been unable to answer the questions of practitioners, and practical management accounting research is still an ongoing topic of discussion (Zimmerman 2001; Hopwood 2002; Ittner and Larcker 2002; Luft and Shields 2002; Lukka and Mouritsen 2002).

According to Malmi and Granlund (2006), there seems to be disagreement in the academic community about what practically relevant management accounting research is and how such research should be conducted. Malmi and Granlund present three ways to produce practically relevant management accounting theories: altering some current practices when conducting traditional research, using normative theories (such as ABC and BSC) as a starting point, and relying more on interventionist approaches. However, Malmi and Granlund do not consider to whom practically relevant management accounting research should be relevant. According to them, "management accounting should provide explanations that are useful for those we study – managers, organizations and society", but all the examples of good research topics presented by them seem to be relevant mainly to controllers and other accounting practitioners. If accountants constitute an internal service function, the users of accounting information should primarily be found somewhere other than in the financial department. Thus, more analysis is needed on what are the groups of non-accounting people relevant to business and business development and what their needs regarding accounting information are. In other words, when considering pragmatic relevancy, the users should probably define what is relevant to them. They are the people who encounter the challenges in the business environment and financial analyses just might help them to cope with them. Provocatively, if management accounting research is done mainly for accountants and the problems regarding how to develop a business and cope with the changing business environment is excluded, one can ask whether empirical data and real-life understanding are needed at all.

As Malmi and Granlund (2006) suggest, interventionist research is one possible way to produce practically relevant management accounting research. According to Jönsson and Lukka (2005), interventionist research should be viewed as one form of case studies, where the researcher is more or less deeply involved with the object of study. According to them, in the same way as case study itself, interventionist research is a cluster of research approaches, which include most notably action research (originating in the work of Lewin (1946) in the field of social sciences), action science (a stream of interventionist research suggested by Argyris et al. (1985)), design science (introduced by van Aken (2004)), clinical research (see e.g. Norman 1975 (in Jönsson and Lukka 2005)) and constructive research (see e.g. Kasanen et al. 1993; Lukka 2000; Labro and Tuomela 2003). Moreover, also innovation action research by Kaplan (1998) and the conditional-normative research approach (see Mattessich 1995) can be seen as forms of interventionist research. The alternative forms of interventionist research differ for example in the importance they attach to the practical and theoretical views of the study and the degree of intervention of the researcher. The boundaries between the various streams of interventionist research are, however, blurry and none of the research streams has much distanced itself from Kurt Lewin’s original ideas (Jönsson and Lukka 2005).

Considering interventionist research, the manner of producing theoretical contribution that is of interest to for the academic community and has potential for publishing is different from the traditional non-interventionist research methods. Therefore, interventionist research should not be judged by the criteria of positivist science, but rather on its own terms (Gummesson 1993;
Coughlan and Coghlan, 2002). According to Lukka (2000), there are two possible ways to produce a theoretical contribution using the constructive research approach. First, the construction itself can be a novel way to achieve something and, secondly, constructive case research can serve the purpose of developing, illustrating, refining and testing a theory. In other words, both successful and unsuccessful implementations of new constructions can lead to refinement of existing theories or the formation of new ones. Jönsson and Lukka (2005), on the other hand, identify potential outputs of different phases of an interventionist research to be:

- capturing and analyzing the situation in the case company
- outlining the ideas for change or a design of a solution concept
- testing the ideas for a change of the designed solution concept by participating in its implementation
- reflection of the nature, elements, implementation and effects of the change ideas

They stress that while outlining the ideas for change or designing a solution concept are distinctive unique features of interventionist research, the task and output involved here do not differ from those in non-interventionist studies. Thus, the general case literature and that dealing with qualitative methods (see, e.g., McKinnon, 1988; Eisenhardt, 1989; Birnberg et al., 1990; Gummesson, 1993; Keating, 1995; Lukka and Kasanen, 1995; Humphrey and Scapens, 1996; Ahrens and Dent, 1998; Marshall and Rossman, 1999; Llewelyn, 2003; Modell, 2005) in which the analysis of data is handled is equally valid for interventionist research (Jönsson and Lukka, 2005). The grouping of Jönsson and Lukka (2005) is one possible way to structure the theoretical contribution of an interventionist study. This grouping is followed also to a certain extent in Section 3 of this paper, where the interventionist research project is presented.

Despite the potential of interventionist research to produce practically relevant contribution, the number of published interventionist studies in the area of management accounting is limited (Labro and Tuomela, 2003) and the new approaches introduced in the 1990s (constructive research by Kasanen et al., 1993, innovation action research by Kaplan, 1998) and conditional-normative accounting by Mattessich (1995) have had a very limited impact on actual research practices (Malmi and Granlund, 2006). One possible reason for this is that positivist ideas (see, e.g., Watts and Zimmerman, 1978, 1979, 1986) originating in the natural sciences are still dominant in many areas of business research and academic paradigms are slow to change (Labro and Tuomela, 2003). Normative research linked with intervention of the researcher encounter especially strong suspicion (Labro and Tuomela, 2003). This type of research is considered consulting, although many distinctions can be drawn between interventionist research approaches and consulting.

According to Lukka (2000), one of the differences between constructive research and consulting is that the constructive research process includes achieving deep understanding both empirically and theoretically of the subject being studied. The same applies also to other forms of interventionist research. In addition, it is common in consulting that existing practices and technologies are applied into a new context with only moderate changes to the existing model (Westbrook, 1995; Labro and Tuomela, 2003), whereas in interventionist research the idea is to understand the specific context and formulate new solutions based on the features of the context. Moreover, consultants rarely have the time and interest to reflect on the generalizability of the solutions they have adapted in one particular environment (Westbrook, 1995; Eden and Huxham, 1996). However, probably the most important difference between consulting and interventionist research is that the objectives of consulting are congruent with the objectives of the case company, whereas in interventionist research the objective of the case company is only part of a bigger objective to produce new knowledge (Westbrook, 1995). This presents challenges to interventionist research because the
objectives of the case company and academic objectives might not match at all times during the study (Gummesson 1993). Making these challenges visible when reporting interventionist studies would make it possible to have a wider discussion on the challenges imposed by interventionist research and on the role of the researcher in the research project. This, on the other hand, would more explicitly bring out the differences between interventionist research and consulting.

There are also other possible reasons for the small number of published interventionist studies. According to Hopwood (1983), the academic reward structure does not favour long-term research projects and, on the other hand, the deep understanding necessary for good interventionist research takes time (Labro and Tuomela 2003). Thus, it might be more tempting for researchers to conduct a short-term research project using other research approaches than to engage in interventionist research lasting years and still not guaranteeing any academic rewards. Moreover, the disappointingly small amount of published interventionist studies has left researchers without guidance on how to conduct this type of research (Labro and Tuomela 2003). General advice concerning the way in which interventionist research or field research in more general should be conducted (see e.g. Eden and Huxham 1996; Coughlan and Coghlan 2002; Jönsson and Lukka 2005) is helpful, but actual examples of interventionist studies would enable researchers engaging or thinking of engaging in such studies to see for example, how a theoretical contribution has been produced from these interventionist studies. The lack of published interventionist studies is not, however, totally the fault of publishers’ not supporting the publishing of long-term interventionist studies, but is also due to the manner of reporting interventionist and more general field studies. Reports of these studies are usually focused on presenting the results rather than the challenges encountered during the research project, and thus they do not promote a wider discussion concerning conducting and publishing practically relevant management accounting research.

THE CASE: COST EFFECTS OF MASS-CUSTOMIZED HYDRAULIC POWER UNITS

Starting the Research Project – Getting Acquainted with the Business

The interventionist research project presented in this paper is based on long-term cooperation with a wholesaler of hydraulic components who also manufactures hydraulic power units. Research cooperation with the case company had been started already in 1999 with a year-long research project focusing on cost management in technical wholesale business. To continue the work, a two-year research project was started in 2002. However, at the same time, another research project concerning the cost effects of mass-customized materials handling equipment was being conducted in another case company. Despite the fact that this research project was mainly focused on management accounting, the researcher had developed new cost-effective solutions for mass-customizing materials handling equipment (some of which were also patented). The CEO of the hydraulic company showed interest in those solutions and in autumn 2003 the focus of the cost management project was shifted from wholesale business to the development of mass-customized power units. Consequently, this paper is also focused on that. A hydraulic power unit is functionally comparable to a pneumatic compressor. However, instead of pressurized air, it produces pressurized oil to be used in a hydraulic system. An example of a hydraulic power unit can be seen in Figure 1. In the figure, all the major elements of a typical power unit (steel constructions, including the tank and the platform, pump units, some hydraulic blocks with valves on them and other accessories) can be seen. The case company manufactures approximately a couple of hundred power units per year, most of which are highly customized and managed as projects.
The case company is a subsidiary (sales company) of a globally operating hydraulic component manufacturer and one objective of the case company’s power unit manufacturing is to sell hydraulic components of the parent company. The product assortment of the parent company is very broad and over the years the emphasis on customer-orientation and a broad component assortment have led to an explosion in the number of components in the case company. Manufacturing unique customized power units has profiled the case company as a technical market leader, but the power units manufactured by the case company are more expensive and have longer delivery times compared to those of competitors. Therefore, in order to increase its competitiveness, the case company had started to develop a product family of modular power units. To increase modularity, the company had started to standardize component use by defining product groups that should be prioritized when designing power units. To support this, different selection charts had been introduced from which the designers could easily choose, for example, correct drives for standardized pumps and the necessary couplings. In addition, to speed up the delivery process of the platform and tank, a selection of standardized base and tank structures had been developed. The use of material in these structures was optimized and the requirements of the supplier’s manufacturing equipment were also taken into account.

In order to form a basic understanding of the power unit business and the challenges of mass customization in it, the researcher spent a week working in the assembly in autumn 2003. In addition, the researcher participated in the monthly development sessions and made different types of analysis concerning the business in general and power units in particular. The actual research project aiming at mass customized power units was started in summer 2004. The objective was to actively participate in technical development work and support the work with the necessary cost analyses. At this point, another researcher responsible for cost reporting joined in. Regarding power unit manufacturing, it was possible to identify four levels of cost reporting. First, power unit manufacturing is a business unit with business unit-level cost reporting. Second, the profitability of individual sales transactions, i.e. projects, is naturally followed, and these projects are usually divided into several positions. For example, a power unit itself would make one position while the operating devices with necessary control systems and valves would make the other. In addition to materials and manufacturing work, also engineering is seen as a direct cost element and is assigned
to each position. Manufacturing in the case company consists mainly of assembly work, and therefore only material costs are reported at component level.

During the research project, some defects in cost reporting were identified. Although the gross margins of different projects seemed to be, on average, satisfactory, the profitability targets of the whole business unit were not achieved, which confused the management. The profitability of the business unit was managed mainly using a summary report of planned project costs and the business unit income statement. Although the actual costs assigned to the individual positions and projects were available, summaries of these costs were missing (left in Figure 2). When a summary report of actual project costs was created (middle cost structure on the right in Figure 2), it was noticed that actual material, assembly and engineering costs were typically a couple of per cent higher than the planned costs. The projects with the biggest variations were analysed at position level to identify the cost elements causing those variations. In addition to the variations in actual costs and planned costs, the income statement includes direct costs that are not reported at project level. These include, for example, production manager, production controlling people and unused capacity of engineering and manufacturing. These cost elements, then, explain the rest of the variation between planned direct costs and direct costs in the income statement. The income statement includes also the costs of the sales department and allocations of other administrative expenses, the reporting of which was made more detailed.

![Figure 2. Development of cost reporting at business unit level (the figures have been changed for confidentiality reasons).](image)

Although in Figure 2 the results seem quite straight-forward, the above-mentioned development efforts required a surprisingly large amount of work. Some of the deficiencies in cost reporting are related to the recent implementation of a new ERP system because some of the necessary reports were simply not available yet. In addition to the development of reporting at the business unit level, reporting on project and position levels was developed by dividing manufacturing into four cost centres (assembly, painting, testing, cabelling) in order to obtain more accurate hourly costs for different activities. Cost reporting in manufacturing seemed to be in order, but design engineers often just wrote down the planned engineering hours for projects and positions instead of the actual number of hours. Thus, reporting of engineering work had to be improved.

As can be seen from Figure 2, the proportion of material costs from total costs is rather high, which is explained by the fact that the case company’s manufacturing is mainly assembly work and all the components are bought from the parent company or other suppliers. In addition, it can be seen that the sales department is a rather large cost element. Sales people (sales engineers) have a technical education and they are involved in designing the hydraulic system for the customer already during the offering phase. Thus, the difference between sales engineers and design engineers is not that big and actually some of the work done by sales engineers could just as well be assigned directly to
projects. However, although engineering is seen as a direct cost, the work of sales engineers and other indirect workers (e.g. production manager, production control people, purchasers, storemen) is not followed at the project or position levels. Thus, no data is available on how different projects and positions actually burden these activities.

**Developing Mass-Customized Solutions – Savings in Indirect Project Management Activities**

When the research process focusing on mass customization was started in 2004, employees in different departments were interviewed to survey the current state of the modularization project. In all departments, modularization was regarded with suspicion. Customer-tailored power unit projects were seen as their area of strength, and especially according to the sales engineers, modular solutions would restrict component use, and thus only weaken their competitiveness. In addition, the modular steel constructions were criticized. The purchase price of a basic tank was OK, but the supplier charged almost an equal amount of money for making the necessary holes which, then, made it too expensive. This criticism drew the attention of the researchers and the process of manufacturing tanks and platforms came under the spotlight. Several employees of the tank supplier were interviewed to map the biggest problems and clarify the pricing. According to the supplier, the platform and tank had been offered with only basic holes in them. At that point, the case company had not mentioned that every platform and tank would still require lots of project-specific changes. A modular tank of a certain size and the very same tank with project-specific holes and accessories are presented in Figure 3.

![Figure 3. Standard tank and the one with project-specific holes.](image)

Because the steel constructions form the interface that all the components are attached to, the selected components define how many and what kind of holes will be required. Thus, the entire hydraulic system must be designed before hole drawings can be made. However, because steel construction forms the physical platform of the product, it is needed in the assembly first, which means that these steel constructions easily become a bottleneck of the whole delivery process. The employees of the case company had not realized that the problems with steel constructions are not caused by the suppliers; the main reason for these problems is rather the long lead-time in design. Because steel constructions are bottlenecks, and at the same time rather inexpensive (5-10 per cent of the total value of the power unit), they are excellent targets for efforts to make them common
components enabling mass customization. The objective was that with a limited number of completely standardized platforms and tanks it would be possible to assemble numerous different power units. However, in addition to modularization, new flexible and adjustable solutions needed to be developed.

Because power units had been customer-specific designs, previously the components had simply been selected according to particular customer needs. However, analysing the entire product population helped to understand how certain component changes are reflected in the product and what these changes mean in practice. For example, certain accessories are related to the size of the tank, and thus they can be defined as standard components for different tank sizes. Similarly, the size of the tank defines the maximum volume of the hydraulic pump, which means that one tank would only require certain sizes of pump attachments. In addition, the volume of the pump and the power of the drive define the height of the pump attachments. Previously the positioning of the pump attachments was carried out in the laser cutting process (resulting in project-specific sheet metal parts and thus also in project-specific steel constructions), whereas with the mass-customized solution the position always remains the same and the changes in height are taken into account with new drive attachments. Furthermore, there are some larger openings on the top of the tank that enable a customer-tailored cover to be manufactured, depending on the application of that particular power unit. With these solutions, the steel constructions can be manufactured in advance, and customer requirements can be taken into account without any changes in these parts. The development of these solutions (Figure 4), including the necessary analyses, prototypes and iterations, took over a year before they could be introduced internally to the employees. These solutions enabling mass-customized steel constructions developed by one of the researchers have been patented, which describes the novelty value of the solutions within that particular business.

Figure 4. From standardized steel constructions and customized holing to mass-customized steel constructions. The role of cost of over-specification is debatable.
Once the concepts for mass-customized power units were ready, the interesting question was what kind of cost savings these new solutions make possible. If, for example, the time needed for making the hole drawings (designing the steel constructions) had been measured in each project and the new steel constructions no longer needed any significant design efforts, the cost effects of the common steel constructions would have been easy to point out. However, despite the improvements in cost reporting, direct costs (apart from materials) were still only measured at the position level and indirect costs at BU level. Thus, the costs of designing the project-specific steel constructions or of choosing all the parts for certain modules could not be verified. The same applied also to assembly work, not to speak of indirect costs (sales people, production manager, operations management people, purchasers, etc.). In order to obtain at least some understanding of the phenomenon, the cost difference between a mass-customized power unit and a customer-specific power unit (managed as a project), was estimated. That, on the other hand, meant that the effects of modularity, component standardization and component commonality were all measured together.

One interesting aspect in the case of mass-customized power units is that the sequencing of the activities seems to remain the same. The sales engineers and design engineers define the customer needs and configure a suitable power unit, as before. The same number of steel constructions need to be ordered and the project must be managed based on the delivery time requirements of the customer, as before. Thus, transaction drivers typically used in analysing the cost effects of component commonality (see e.g. Thyssen et al. 2006) seem not to work in this case. However, with the mass-customized power units, many of the activities can be performed much faster compared to the project-specific power units. Therefore, in order to measure the changes, duration drivers (see e.g. (Kaplan and Cooper 1998)) were to be used (no examples of how to use duration drivers in the context of component commonality have been found in the literature). Hourly rates of different activities were calculated with an ABC model and the activity assignments were made following the basic idea of time-based ABC (Kaplan and Anderson 2004), i.e. the development team estimated the activity durations in the case of mass-customized and project-specific power units. The resulting analysis is shown in Figure 5.

The analysis in Figure 5 shows that the cost savings potential seems to be rather significant and that the largest potential comes from indirect activities. The analysis does not take into account the potential changes in material costs at all, even if the new mass-customized steel constructions have turned out to be much cheaper than the structures used previously and some hydraulic components have also been replaced with cheaper ones.

![Figure 5. Cost effects of modularization, standardization and component commonality in the case company (the figures have been changed for confidentiality reasons).]
For many managers involved in the mass customization project, the main objective had been to decrease the purchase price of steel constructions. With the analysis shown in Figure 5, the managers started to realize that instead of the purchase price, the largest potential for cost savings is in various indirect activities. That, on the other hand, is not reflected in direct costs, but rather in gross margin. Thus, despite the aggregate level of analysis, the results shown in Figure 5 have turned out to be rather interesting and inspiring. The cost analysis is certainly nothing but a rough estimate, but the company management regards that as sufficient. According to the managers, the next challenge was not to improve the calculations, but to launch the mass-customized solutions. Once the company had sold a couple of dozen mass-customized power units, also the cost reports would start to indicate how the costs behave in real life.

In order to form the basis for launching the new solutions, the first version of a mass-customized power unit and the above-mentioned cost analysis were introduced to the sales engineers and design engineers in autumn 2005. Considering that the sales department had been demanding tools for facilitating the offering process and reducing the delivery times, the solutions making mass customization possible as well as the cost analyses were given a rather cold reception. The sales engineers saw no potential in applying these solutions with their current customers and the mass-customized solutions were only expected to hurt the company’s reputation as a provider of technologically superior products. With the cost analysis, the biggest interest was in questioning the results. Naturally, some relevant feedback was received, but the sceptical and even somewhat ironic attitude towards the development efforts certainly was a surprise. In the end, the solutions were expected to eliminate precisely those problems identified a year before.

The sales director proposed that they should set up an example and sell a few mass-customized power units themselves, and thus the search for a pilot customer was started. One domestic machine constructor with significant annual potential was about to change its current power unit supplier as soon as the contract period with it expired. In January 2006, the sales director introduced the mass-customized power unit concept to this customer. The customer considered the solution to be quite interesting and asked for a reference offer regarding the power unit they had just purchased elsewhere. That, on the other hand, truly sped up the development process. One essential aspect of the mass-customized solution is to replace some customer-specific components that have quite difficult purchasing processes with cheaper standard components of similar functionality. This, together with the mass-customized steel constructions, decreased the referenced sales price by over 10 per cent. At this point, no attention was paid to changes in indirect activities because, in the end, the effects were really not that well understood. However, the customer must have considered the price to be agreeable since suddenly in May 2006 they sent an offer request for six power units. The customer had some special requirements regarding certain components and structure solutions. However, the offer was based on the mass-customized solutions and standard components, whereas the price for the special requests was shown separately. Thus, the mass-customized power unit was used as a point of reference in price negotiations. The sales management found it essential that for the first time they had the chance to introduce a standard solution already during the offering process and explicitly show the impact of customization on price. The customer did not approve the drive attachments, which had to be redesigned. Surprisingly, with some minor changes, all the pump models used by the case company could now be attached using the same steel constructions, which then increased the applicability of the mass-customized solutions significantly. During spring 2006, a project-specific power unit was sold to the customer, and it was decided to test the mass-customized steel constructions with that power unit. Thus, a power unit consisting mainly of
customer-specific components was build on top of the mass-customized steel constructions. This is shown in figure 6. When this power unit was in production, the customer quite suddenly decided to buy all the other six power units, which was a breakthrough since that customer had never before bought all of the power units needed for one application from the case company.

![Image of power unit with customer-specific components and mass-customized steel constructions.](image)

Figure 6. Power unit with customer-specific components and mass-customized steel constructions.

In addition to the technical development, also the understanding of the accounting context had increased during the process and some major deficiencies had been identified. First, the cost comparison of the project-based and mass-customized power units (Figure 5) was somewhat problematic since the company had never delivered a power unit technically comparable to the mass-customized one. The project-based power units of similar size had been technically more complex, which reduced their comparability. Therefore, the problem in Figure 5 is not the estimates regarding the mass-customized power unit, but rather the cost estimates of the project-based one. However, in spring 2006 one power unit had been sold to the same pilot customer using the standardized (not the mass-customized) steel constructions with customer-specific components and thus, also holes. That power unit could have been replaced with a functionally comparable mass-customized power unit and when that power unit was designed and assembled, the problems with cost tracing had already been taken care of. Thus, it was a perfect example regarding the cost structure of a customer-tailored power unit (left in Figure 7) replaceable with a mass-customized one. With the offering process, the material costs of the similar mass customized power unit were analysed (middle in Figure 7) and, naturally, the effects of the customer-specific changes on material costs had also been taken into account (right in Figure 7).

All the other cost elements in Figure 7 have been shown with dashed lines, because no complete mass-customized solution has been configured or manufactured. With the customer pilots, some engineering work has been required for commercializing the new solutions, which clearly takes more time than if the power units had been configured from existing solutions. Similarly, in addition to the first prototype case, these power units have been the first versions of mass-customized solutions in manufacturing. This means that the assembly times for these power units are probably somewhat higher than what they will be for mass-customized solutions in the future. In addition, there have been some problems typical of ramp ups. So, even when the research cooperation has lasted already nearly three years, still some more time is needed before the cost reports will start to indicate cost effects in direct costs. In addition, the most important cost savings are assumed to be achieved with indirect costs (project sales and project management related activities), but it is unlikely that the case company will ever measure them at project or position level. Therefore, the estimations described in Figure 5 will most likely be the only realistic approach for analysing the behaviour of these costs.
Another challenge related to the cost reporting is the appearance of a new cost object. Previously an offer was constructed by defining all necessary components and after that assembly and engineering hours were estimated at position level. With mass-customized solution, the power unit is configured using preexisting modules that include all the necessary components. However, the price of a module also includes the estimated assembly time and the time needed in engineering for choosing the right module (the module has been already designed, but it takes some effort to calculate what kind of module would be needed in different applications). Thus, an interesting question is, should these costs also be measured at module level, which would enable these estimated times, i.e. standards, to be verified and, if needed, adjusted. If that is considered appropriate, it will mean a significant change in cost reporting and, naturally, systematic real-life data cannot realistically be expected for years.

DISCUSSION

This paper has discussed an interventionist long-term case study conducted in cooperation with a company that manufactures hydraulic power units. The objective of the research project was to create mass-customized product concepts for improved cost efficiency. Following the ideas in the interventionist research approach, researchers have been involved in the development of cost efficient solutions for mass-customization and they have also been responsible for cost estimates and cost analyses needed for the development process. However, an interesting question arising from the case is whether such an interventionist research process which takes into account the pragmatic needs of the organization and decision-makers (at least to a certain level) is capable of producing results that are also relevant or interesting to management accounting researchers and, perhaps more importantly, how could such a research process produce results considered relevant not only by the managers but also by colleagues in academia. According to Jönsson and Lukka (2005), an interventionist study is capable of producing a scientific contribution in four ways. These include conceptual capturing of the situation in the case company, outlining of the ideas for change, testing of the ideas for change and reflective analysis of the research process itself. These phases can be identified in this research project as well.

The long-term cooperation with the case company had enabled the researchers to become familiar with the wholesale operations and reporting practices relevant to that type of business. However, when the focus was shifted to power unit business, the researchers had to form an understanding regarding the context at hand: their products, production environment and cost reporting. The present state of cost reporting was analysed critically, as well as the steps already taken by the company for mass customization of power units. The role of cost analyses at this phase was mainly
to give financial background information regarding the company in general and power unit business in particular. At the beginning of the project, there were not too many ideas regarding how to proceed with the mass customization and what kind of changes might be required with cost reporting practices. Therefore, it was quite natural to work with whatever problems the researchers came across in the company’s current reporting practices. At the same time, several analyses focusing on the technical aspects of power units were done in order to grasp the functional logic of the product population and the effects that different customization efforts (i.e. changing of certain components) would have on the products.

About a year later, new ideas for mass customizing the power units surfaced, which, then, initiated the second phase of the research process. Some improvements in costing practices were made, but analyses done by the researchers were clearly focused on how to apply the newly invented mass customized solutions in practice. This phase was a long and iterative process taking more than two years. When the first product concepts were ready, the interest was transferred to product cost analyses because the development team wanted to understand better the cost effects of the new mass-customized product concept. In addition to the technical development, this phase also included the preliminary cost estimates of the developed solutions, which, on the other hand, required some innovations regarding how to measure cost effects of mass customization in such a pragmatic context. The role of cost analyses at this phase was to motivate the managers to implement the new solutions by presenting the cost reduction potential embedded in the new solutions. The cost estimates certainly were not fancy simulations but rather practical activity-based cost analyses. Despite the aggregate level, the cost estimates still illustrated to the management where the biggest cost savings would actually be found. It was not attempted to produce cost savings in purchase price of steel constructions (as expected by many of the managers), but rather via indirect project-management-related activities. Despite the obvious weaknesses, managers considered the calculations accurate enough to start implementing the solutions in practice which, on the other hand, meant that the cost estimates passed at least the weak market test. According to the managers, more accurate cost analyses would be done as soon as the new solutions had entered the market and achieved a certain volume.

After three years of close cooperation, the third phase of the interventionist research project, i.e. testing the solutions, has just been commenced. In this case, testing not only concerns the new product concepts and their implementation but also the preliminary cost estimates. At the beginning, the focus quite naturally is on the product solutions and a few customer projects will be required until all of them have been tested and put to commercial use. However, with the cost estimates, completing the third phase is likely to take several years. At this point, material costs of the mass-customized power units are well known, but volume increases and the possibility to use suppliers in low-cost countries for the steel constructions should decrease the costs even further. When the first prototypes are in production and engineering, there is still plenty of development work involved and thus the cost reports will not indicate the real cost reductions until the new ways for configuring power units are well established in assembly and engineering. In order to improve the quality of offering processes, the direct activities (engineering and assembly) would have to be reported at the module level and it is not certain whether that step will be taken or not. Furthermore, verifying the effects on indirect work will be difficult since, first, these activities will probably never be traced at project level, not to speak of at module level, and, second, there does not seem to be accurate yet measurable activity drivers available for estimating these costs reliably. Thus, in this practical context, the method used in the first cost estimates might actually be the best possible way for analysing the effects of mass customization on indirect activities.
The fourth phase of an interventionist study, reflection, has been to some extent part of every phase of the research project, but now that the research project is coming to an end (the research cooperation will be continued if proper funding can be arranged), reflection will be emphasized. Naturally the role of the researchers as change facilitators is of interest, but from this paper point of view, the role of cost estimates and cost reporting is likely to be more interesting to management accounting researchers. On the basis of this case, it seems that more improved cost reporting has created preconditions for analysing the cost effects of the mass-customized solutions. So even if only small part of cost analyses will be of academic interest, quite much development effort was needed in order to obtain them in the first place. Different interventions taken in cost reporting are illustrated in Figure 8.

![Figure 8. The role of cost reporting in the research project.]

In that figure, the initial state of cost reporting is presented roughly on the left and the cost analyses made during the research project, i.e. the development efforts of cost reporting in general and the product cost analyses in particular, are shown on the right. The first row illustrates the development efforts taken in business unit level cost reporting (see Figure 2). The most essential part of this was the business unit level summary report of the costs assigned to projects and positions. In addition, the indirect costs assigned to the business unit were also analysed in more detail. With project and position level cost reports, the development efforts were on dividing the assembly into several cost centres and making sure all the material costs and engineering hours are assigned properly. Mass-customized products introduce a new cost object (4th row in Figure 8). When configuring a mass-customized power unit, material, assembly and engineering costs are defined at module level, which increases the accuracy of offerings. However, only the material costs are traced at module level and an interesting question is whether the other direct costs should also be measured at module level. That would enable the planned costs to be verified, but, on the other hand, it would mean significant changes in cost reporting and the case company does not want to do that unless the volumes of modules become significant. Then it would be possible to separate module assembly from normal...
power unit assembly, and costing practices similar to those in standard product environment could be implemented in module assembly.

In the case of product cost analyses (right column in Figure 8), the first cost estimate regarding the effects of mass customization (Figure 5) has turned out to be somewhat problematic. The original idea was to measure the cost effects of mass customization at module level (e.g. the design time needed for the steel constructions) but the employees found it too difficult to estimate activity durations at that detailed level. So, in the analysis, a project-based power unit was compared with a mass-customized one. However, it has turned out that the cost object might not have been totally clear, and it seems that the analysis was actually done at project level. Thus, in the design times there were also included some valve units and other components that are not part of the power unit. The cost analyses involving the first pilot cases (Figure 7), on the other hand, are clearly measured at the position level. However, only the estimates used for offerings include costs other than material costs because at this point there are product development costs and production ramp-up costs involved and it will take some time before the cost effects of mass customization can be seen in cost reports. Furthermore, the first pilot cases include components and solutions that are not included in the mass-customized solutions and that is why three power units are being compared instead of two. In retrospect, the development efforts shown in Figure 8 form a logical entity, although Figure 8 does not illustrate the iterativeness of the research project. For example, the development of BU level cost reporting certainly was started at the beginning of the project, but the biggest efforts were made during the last six months when specific needs for analysing business unit profitability arose. Similarly, the first product-level cost estimates (enabling the comparison between a customer specific power unit and a mass customized one) were made when the actual solutions were still in the process of formation. Significantly more effort was put into cost reporting when the technical solutions entered production and it was possible to obtain real-life data for decision-making.

The intervention and thus the change process supported and promoted by the researchers in this research project were quite different from accounting studies in general, because in this case the researchers were actively involved in managing the product development process. Therefore, the question is whether the researchers actually were more than just change facilitators and if so, what problems would that cause. In other words, the actual intervention was not limited to the development of accounting practices; on the contrary, the researchers were responsible for finding new ways to configure mass-customized power units (one of the researchers actually owns the patents for the solutions). That, on the other hand, was an excellent opportunity for the researchers to obtain first-hand experience of the problems related to mass customization in that type of environment and thus it enabled quite a good understanding of that particular accounting context. Therefore, are the findings regarding the cost effects of mass customization of less value because the researchers have been deeply committed to them? There certainly was not much point in analysing cost effects of mass customization without the technical innovations enabling it and thus research intervention focusing only on cost reporting practices and cost analyses simply would not have been enough. It would have been quite impossible to measure the cost effects without deep involvement in the process, because the context would not have been understood well enough. Thus, it seems that the technical solutions simply had to be made until it was possible to understand their cost effects within that organization.

In the literature, empirical studies regarding cost effects of component commonality (one objective of mass customization is to increase component commonality) have focused mainly on direct costs as well as on logistics and other inventory-related costs. This case has been one of the first attempts to explicitly measure the cost effects of component commonality in engineering and sales activities.
In addition, practically all published cost analyses have been based on the use of easily measured transaction drivers, and duration drivers have never been used in analysing cost effects of component commonality. Thus, the deep involvement has, in the end, lead to interesting results also from the management accounting research point of view, but it certainly has not been an economical way of making a scientific contribution. With the first cost estimates of the new solutions, the commitment of management increased significantly. Thus, the responsibility and motivation for promoting the change process had clearly shifted more to the managers of the case company. In other words, now when the benefits of the new product concepts are becoming visible, the managers simply seem to prioritize the development process and, consequently, the researchers are able to focus more on the necessary preparations for collecting cost data to verify the previous cost estimates.

The presented research project highlights also some other issues that should be interesting from the management accounting research point of view. First, what is the role of accounting in an interventionist accounting study and, in comparison, what is the importance of non-accounting-related activities needed for the intervention itself? In the interventionist real-life development project described in this article, the management accounting researchers could not restrict themselves to management accounting-related issues. Rather they had to be engaged in the change process more generally. That, on the other hand, meant significant reduction in the efficiency or performance of the researchers in making a contribution to the management accounting field. The pragmatic relevancy for the case company, or more broadly for managers struggling with similar problems, should not be an issue. However, the interesting question is whether the process of producing pragmatically interesting results is or has to be that long and whether it is possible to produce pragmatically relevant results without deep commitment to the topic and involvement in areas other than just accounting. Thus, the question of how to produce management accounting theory with pragmatic relevancy cannot be answered simply by stating that the research should be conducted in cooperation with companies. The issue seems to be more complicated.

Furthermore, the research project illustrates how long a time span an interventionist management accounting study might actually require in practice. The project has focused on mass customized power units for about three years and, despite this rather long time period, the mass customized product concepts are only now being tested, which, on the other hand, means that actual cost reports might still need a year or two for completion. In addition, the research project points out that a study with pragmatic relevancy can actually include much more than the development of new and innovative management accounting tools, which means the problems and challenges of accounting systems are not necessarily theoretically complicated. On the other hand, it might actually take quite a long time even for an experienced researcher to identify problems and possible distortions in cost reporting practices. Therefore, it might be unrealistic to expect someone to be able to know in advance what the quality of cost reporting in a particular company really is, and thus the idea that interventionist management accounting research should only be conducted in companies with advanced reporting systems seems unrealistic.
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