Paper 2

Developing integrated solution offerings for remote diagnostics: A comparative case study of two manufacturers

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Abstract

Purpose – This paper analyzes two manufacturing firms entering condition based maintenance business reveals the complex nature of establishing integrated solutions. Existing literature on integrated solutions is contrasted critically against empirical findings.

Design/methodology/approach – Descriptive, comparative case study focuses on solution offerings in two different companies. The data consist of 57 thematic interviews of both manufacturer and customer representatives and company documents.

Findings – In integrated solutions, value is created incrementally through the customer-provider co-production process. Building integrated solutions business requires managing the interdependence of

the solution components – both within the provider company and the offering, and between the provider and the client – to enable this collaborative process.
Research limitations/implications – The case studies were first conducted separately and later compared. However, despite some minor differences in case methodologies, no problems were encountered in the comparative analysis of the data sets.
Originality/value – The paper departs from the canons of earlier literature as it proposes a revised definition for integrated solution offerings; it emphasizes balanced amalgamation of multiple perspectives instead of just replacing the old ones; it questions the view of solutions development as a straight-forward implementation process; and it switches perspective from the manufacturer to the business of the client as the main system.

Keywords: Industrial services, Maintenance programmes, Manufacturing industries, After sales service

1. Introduction

Physical goods no longer provide sufficient competitive advantage for manufacturing firms as new value sources are found in services and integrated solutions (Oliva and Kallenberg, 2003; Phillips et al., 1999; Slywotzky, 1996; Slywotzky and Morrison, 1997; Wise and Baumgartner, 1999). Integrated solutions are complex and customized offerings that extend beyond mere bundles of services and products (Johansson et al., 2003). These solutions can create value by improving operating efficiency, increasing asset effectiveness, enabling market expansion, and mitigating risk (Cornet et al., 2000). In the literature, solutions are viewed as a way for manufacturers to turn away from problems experienced in matured businesses, such as tighter margins and competitive pressure (Davies, 2003b; Shepherd and Ahmed, 2000; Wise and Baumgartner, 1999). The literature conveys a picture of the transformation into solutions as a rather straight-forward implementation of generic process steps (Brady et al., 2003, p. 103; Cornet et al., 2000; Shepherd and Ahmed, 2000), such as the transformation of organizational processes (Cova and Salle, 2007, pp. 142-3), the redesign of organizational structure (Galbraith, 2002) and the gaining of customer allegiance (Wise and Baumgartner, 1999). This straight-forward view of the transition process is, however, challenged by some studies indicating that the process may be extremely onerous for the firm (Brax, 2005; Johansson et al., 2003).

In the provision of integrated solutions, customers, and providers set out to work in close collaboration. Thus, to provide unique customer value, the provider needs to understand the customer business in detail (Davies, 2003b; Shepherd and Ahmed, 2000; Wise and Baumgartner, 1999). Even though customer focus has been recognized as fundamental in the integrated solutions business (Brady et al., 2005; Miller et al., 2002), existing research has so far concentrated on the manufacturer's perspective when exploring the process of moving into the solution business (Brax, 2005; Ceci, 2005; Cerasale and Stone, 2004; Davies et al., 2006; Oliva and Kallenberg, 2003).

The existing literature conveys a somewhat controversial picture of the solution transition process as challenging, yet possible to achieve through implementation of generic process steps, and mainly focuses on the manufacturer's perspective. This paper contributes to the study of product-to-services-and-solutions transition by incorporating the customer perspective and opening up the complexities faced by the case firms for a critical discussion. The paper is a comparative, intrinsic case study of two capital goods manufacturers, and their customers, in the process of establishing solution businesses based on maintenance of customers' equipment.

The paper is organized as follows. First, we define and discuss the concept of integrated solution offerings. We continue with methodological description, present the findings from the comparative analysis, and discuss our general conclusion. This is that solutions are based on a long-term systemic orientation, and that the prevailing mass production orientation hinders achieving the level of integration required in solutions. In addition, we illustrate the nature of integrated solutions development as context-specific problem solving, instead of straight-forward implementation of generic process steps.

2. Rethinking the concept of integrated solution offerings

Goods and services are two intrinsic parts in a solution offering (Davies et al., 2006; Oliva and Kallenberg, 2003; Windahl et al., 2004; Wise and Baumgartner, 1999). Services can be viewed as offerings where the core provides value in essentially intangible forms and that are consumed at the moment they are produced (Grönroos, 1990, p. 27; Quinn, 1992). Thus, service offerings are process-based, i.e. the core of the offering is a process (in comparison to goods, which are sold as the outputs of a process). The industrial marketing literature has traditionally viewed services in a supporting role or as subordinates to the physical good: promoting tangible sales or strengthening customer relationships (Cohen

and Whang, 1997; Levitt, 1980; McQuiston, 2004; Samli et al., 1992). Correspondingly, manufacturers' service strategies have commonly focused on customer service or services supporting a product (Mathieu, 2001a).

The literature on integrated solutions expresses an increasing interest in services as real business possibilities for manufacturers, suggesting that companies can gain competitive advantage by addressing customer needs through combining services with products (Davies, 2003a, b, 2004; Gebauer et al., 2004; Slywotzky, 1996; Wise and Baumgartner, 1999). Proposed trends include offering services that support the customer's operations associated with the provided physical product (Mathieu, 2001a) or even the customer's stakeholder network (Chase, 1991; Cova et al., 2000).

Although the research on these "integrated solutions", "turn-key solutions", or "full-service contracts" (Stremersch et al., 2001) has increased, there is a lack of a common, precise definition for the concept of integrated solution offering. For instance, Brady et al. (2003) define integrated solutions as:

> *[. . .] complete business solutions which involve the integration of products and services into one package.*

And Davies (2003a, p. 339) suggests that:

> *[. . .] firms are selling the idea that their "system" and core capabilities add up to more than the sum of the parts.*

For Miller et al. (2002, p. 3, italics removed), the essence of solutions is that:

> *[. . .] integrated combinations of products and/or services are unusually tailored to create outcomes desired by specific clients or client types.*

We define an integrated solution offering as a bundle of physical products, services and information, seamlessly combined to provide more value than the parts alone, that addresses customer's needs in relation to a specific function or task in their business system; it is long-term oriented, integrates the provider as part of the customer's business system, and aims at optimizing the total cost for the customer. Next, we discuss the logic behind this extended definition in relation to the literature.

Solutions are based on product bundling logic, with a focus on client needs (Ceci, 2005; Cerasale and Stone, 2004). Davies (2004, pp. 735-6) argues that, because client needs are addressed through customization, solutions go beyond traditional bundling. We add that solutions depart from traditional bundling in that the components are seamlessly combined instead of merely added into a package. Nevertheless, all offerings can be conceptualized as bundles consisting of different types of components. Based on this logic, Kotler (2003, pp. 445-6) categorized offerings into:

- pure tangible goods;
- tangible goods with accompanying services;
- hybrids;
- major service with accompanying goods and services; and
- pure services.

In our understanding, solution offerings may represent categories 2-4 of the above-mentioned taxonomy. However, not all such bundles are solutions as defined in this paper, as Kotler's "service mix" may include short-term transactions as well.

The basic assumption in the literature is that goods exist first in the firms' offerings, and the challenge in becoming a solutions provider is related to integrating services into the goods. Traces of this are found when solutions are assumed to be centered on a physical product, typically a capital good. In contrast, Gebauer et al. (2004) call such offerings "product related services" and equate solution offerings with "customer supporting services" including equipment (Mathieu, 2001a, b): instead of the tangible good the focus shifts to the end-user processes related to that product, and the tangible product is encapsulated (Howells, 2000) by the service. Interpreting this, we argue that the recipient (client) of the solution may be the business system of the customer and not necessarily someone identified as a person (Gebauer et al., 2004).

Thus, in solution offerings the marketing mix will increasingly focus on the result or utility achieved by the provided solution (Howells, 2000, p. 15): customers are interested in relieving their problems (ends), the provider organizes the means. The provider thereby becomes a part of

the customer's operations, instead of merely supporting the operations related to the product. Therefore, we argue that the long-term orientation is inherent in the concept of integrated solutions: assuming a role in customer's operations, the provider becomes a part of the customer's business system. Our view has parallels with earlier perceptions of integrated solutions, for instance that the provider takes some of the client's risk, that solutions create value incrementally (Cornet et al., 2000), that strong and symbiotic business relationships stimulate solutions business, and that partnering competence is a fundamental skill for solutions providers (Shepherd and Ahmed, 2000, p. 103).

Integrated solutions are promoted in the literature for their ability to create "unique value" (Miller et al., 2002). Descriptions vary over what this value is and how it is created (Cohen and Whang, 1997; Davies, 2003a; Miller et al., 2002; Shepherd and Ahmed, 2000), but all authors emphasise customer focus. As the components are combined to serve a specific set of customer needs (Cornet et al., 2000), high levels of tailoring and involvement in customer business is required, and consequently solution offerings are typically provided as one-off products. Therefore, they do not lend themselves to economies of scale, but to economies of repetition: after developing a successful customer specific solution the provider actively targets customers with similar conditions (Davies and Brady, 2000; Shepherd and Ahmed, 2000).

The solution perspective differs from project-based business and project marketing perspectives as it emphasizes continuity (Cova and Salle, 2007). This differentiates solutions from the so-called complex products and systems (CoPS), systems selling and the like. Davies and Brady (2000, p. 931, among others) explain CoPS as high-technology and high-value capital goods that are supplied to business users as one-off items or in small batches. Thus, the CoPS may be viewed as project-type offerings, consisting of tangibles and facilitating services, in which the core of the offering is a physical product (e.g. turnkey contracts of capital goods). Consequently, the CoPS provider does not have to become part of the customer's business system, whereas the provided physical system does. Further difference may also be distinguished in the process orientations. Lillrank (2003) categorizes processes into three types: standard, routine, and non-routine. As CoPS are often unique projects, they are assumed to involve mostly non-routine processes. In the case of solutions, setting up the solution system involves non-routine processes, but the long-term orientation indicates a tendency toward routine and standard processes.

We agree with Cohen and Whang (1997) in that the whole life cycle of the capital good should be addressed. Industrial customers consider the total cost-in-use, which is the sum of acquisition costs, possession costs and usage costs (Cespedes, 1994, pp. 47-8), as well as the costs of being a customer (Grönroos, 2000, pp. 132-3). Optimization of total costs in the long run and in the system level is likely to result from the interplay of several value producing mechanisms: integration reduces friction between organizational processes and sub-systems, thus improving efficiency; the (re-)design of the solutions system is more effective; specialized resources can be used more effectively and expertise can develop further; risks can be shared or shifted between parties; the client can receive scale benefits as part of the client base of the solutions provider, and so on.

3. Drivers and competences

Companies are moving into the solution business from different positions (Davies et al., 2006, 2007). In forward integrations manufacturing companies move their value offering point further "forwards" along the value chain, towards services and solution business (Wise and Baumgartner, 1999), while other (service) companies may move "upwards" by integrating physical products into their services (Davies, 2003b). However, for two reasons we expect that the companies most able to compete in complex and capital intensive high-technology solutions are manufacturers. First, the investments in capital goods components of the solutions are larger for non-manufacturers because manufacturers receive a premium for their products. Second, manufacturers of complex products possess technical competences that are difficult to build for non-manufacturers. Thus, manufacturers are expected to be more capable of creating savings through solutions as a result of efficient operation. On the other hand, manufacturers may experience severe problems with the service aspects of solutions (Brax, 2005).

Downstream moves are lucrative for several reasons. In matured product markets, manufacturers seek new sources of revenue. Demand for capital-intensive goods reacts to economic cycles, and services are viewed as providing higher margins with steadier revenue, because their demand is often inelastic, or counter-cyclical in comparison to product life cycle. Services also allow further exploitation of technological expertise in new businesses and form an important feedback loop to product development. Long service contracts provide manufacturers with opportunities to strengthen customer relationships, to solidify their

customer base, and to gather customer knowledge (Cohen and Whang, 1997; Davies, 2003a; Kakabadse et al., 2004; Wise and Baumgartner, 1999).

The increase in solution offerings is not entirely provider-driven. Customers are increasingly demanding broader scopes of service, full coverage of their needs, or more sophisticated offerings (Karmarkar, 2004, p. 105). Single-sourcing, multiple single sourcing and outsourcing may increase efficiency and improve quality of operations – an economical strategy for both sides in tight price competition settings where multi-vendor purchasing is burdening and lengthens delivery time (Anderson and Narus, 2003).

Several organizational competences have been associated with the solutions business in earlier literature, suggesting that integrated solutions cannot be treated as just bundles added to the firms' total offerings; instead they require development of new organizational capabilities. Despite reported challenges in the transition process (Brax, 2005; Gebauer et al., 2004; Johansson et al., 2003; Windahl et al., 2004), the given instructions to build a solution business seem to be quite straight-forward. The focus is on major, generic tasks to be undertaken or capabilities to be built, for instance:

- Cova and Salle (2007, pp. 142-3) identified four major challenges in organizing a firm to enter the solution business: changing the orientation of the firm; the need for new capabilities and skills; the transformation of structure and processes; and implementation of the transformation processes within the firm.

- Galbraith (2002) noted that firms must organize around the customer; the firm should develop its solution strategy, develop a product portfolio, choose what kind of solutions it provides, and manage the order-fulfillment process focusing on the customer front.

- Shepherd and Ahmed (2000, p. 105) suggested that technical competence, integration competence, market or business knowledge competence and customer partnering competence are the basis for integrated solutions.

- Assuming that the company utilizes "economies of repetition", Davies and Brady (2000) have proposed that organizational capabilities for solutions are formed as a cycle of four stages. First, a

> unique solution for a customer is developed in a "first-off" project. Second, the new capabilities gained are disseminated to other projects. Third, the functional organization is reorganized to support this growing business, and finally the organization may become its own business unit (Davies and Brady, 2000, pp. 940-1).

In the literature these tasks are presented as a number of generic steps that the companies need to complete in their transition into solutions businesses. Even though the process may be laborious, the transition is pictured as a rather straight-forward process that solves a number of pre-existing challenges. In the empirical part of this paper we try to open up the complexity of the issues that the manufacturer may face in development of integrated solutions and the required capabilities.

In our framework we have used both solutions – and service management literature (as encouraged by Windahl et al., 2004). The service literature may be applied to solutions for two quite obvious reasons. First, as indicated above, solutions have a strong service component, and companies offering both physical goods and services have been recommended to adopt a service management perspective (Grönroos, 1990). Second, Grönroos (1990, pp. 7-8) holds that in services management the general focus changes from product focus to total utility; from a short-termed transaction view to long-term relationships; from product quality to total customer perceived quality, and total utility and quality as the key process instead of the production of technical solutions. Such refocusing undoubtedly supports providers in generating the systemic synergies expected from solutions settings.

4. Maintenance of capital goods as context for integrated solutions

The maintenance of industrial equipment provides excellent contexts for providing solution offerings. Capital goods are often CoPS offerings, and maintenance as a continuous function brings the long-term aspect that extends the offering into an integrated solution. Availability of reliable maintenance and other support services often facilitate the customer's purchase decision (Cohen and Whang, 1997). Development of such offerings is driven by technological improvements (Agnihothri et al., 2002); for instance, improving equipment uptime is a crucial success factor (Armistead and Clark, 1991).

Swanson (2001) distinguishes three different maintenance strategies. In reactive maintenance, machines are overhauled only when failures prevent operation; in proactive maintenance, preventive and predictive

activities aim to prevent equipment failures; and in aggressive maintenance strategy, the focus is on improving the equipment design to increase efficiency and prevent failures from reappearing. Similarly, Tsang (2002) divides maintenance methodologies into four categories: runto- failure, preventive maintenance, condition-based maintenance, and design improvement. Both categorizations are accurate. Preventive and predictive maintenance share the same goal, while the latter uses advanced technology to optimize preventive activities cost-effectively from "just in case" to "just in time".

Maintenance jobs are traditionally performed as field service on the customer's site. Information technology (IT) has enabled the development of "remote field services" in which predictive maintenance is enabled through direct information exchange between technical systems, i.e. possibly without direct customer contact (Simmons, 2001). Monitoring and diagnosing problems remotely does not, of course, replace traditional field service.

Several benefits have been associated with outsourcing maintenance. The customer organization gains flexibility and is not limited to its current level of capabilities. Providers can offer more focused and technically competent professionals, or use specialized equipment effectively, creating better quality at lower cost. The provider's quality systems, productivity improvement activities and motivational systems support its core business, while for the customer maintenance is a non-core activity. The provider can introduce improvements faster and the customer in turn can learn from external professionals (Campbell, 1995, pp. 19-22).

A balanced maintenance approach acknowledges equipment-, task-, and cost-related performance issues, immediate customer impacts as well as the learning and growth effect (Kutucuoglu et al., 2001). A mutual interest for both parties is to avoid faults and unplanned downtime. Failures generate economic losses in the form of lost production and at worst can lead to safety and environmental hazards. Predicting the occurrence of failures and performing the required maintenance tasks, or replacing parts just-in-time, requires experience and knowledge of the production equipment: possible failures and their indicators must be known in advance. Planning is supported by expert analyzes over longer time periods, as continuous monitoring conveniently gathers the needed data.

5. Methodology

Integrated solutions are complex and unique configurations, making them best studied through case research. Case studies offer flexibility for explorative and theory building research as, during the study, the research scope can be re-addressed, complementary data sources can be acquired, while the method also serves several types of research objectives (Beach et al., 2001; Voss et al., 2002).

The paper is based on qualitative case studies (Klein and Myers, 1999; Walsham, 1993) concerning two manufacturers and their condition-based maintenance solutions. These cases were first studied independently by each of the authors and then compared collaboratively. Despite being gathered separately, the two data sets yielded to comparative analysis without difficulty.

Both studies began by studying the manufacturer organization and proceeded to customer perspectives. The analysis focused on similarities and differences between the cases in order to find critical issues in the development and delivery of integrated solutions. The fictional names "PowerDrive" and "EngineTech" are used because the analysis emphasizes challenges faced by the companies. PowerDrive manufactures hydraulic motors for industrial settings. EngineTech manufactures turbines for industrial settings and publicly owned facilities. Both companies operate globally and have headquarters in Europe. PowerDrive has located its production in Northern Europe, whereas EngineTech's production sites are spread globally. Both companies offer field service and parts for installed products and have been investigating possibilities for improving their after-sale services by remote monitoring solutions for diagnostic and maintenance management purposes. Both, however, have struggled in their efforts for solution development, sales and provision, and invited researchers to diagnose their problems.

In both cases, respondents were selected from the provider organizations and their customer organizations. Internal customers, i.e. units that include the solution or system as part of their broader solutions (full operations and maintenance contracts) and thus constitute customers within the same corporation, were included in the EngineTech case. The data are specified in Table I. The key sources of data were semi-structured interviews and company documents (Yin, 1989). Different internal and external stakeholders were interviewed (Table 1) to provide as broad a picture as possible. The interviews focused on the development of both technology and the business offer, customers' needs or use of condition-based maintenance, expectations of

maintenance solutions, and possibilities and constraints related to the solution. Questions were adjusted to different respondent groups. Interviews were performed on site, allowing the researchers to tour each site and sense the work environment. The interviews were recorded and then transcribed.

Data collection	**EngineTech.**	**PowerDrive**
Time	5-11/2002	8-11/2003
Interviews	36	21
Length	45 minutes-3 hours	45 minutes-2 hours
Conducted by	First author + colleague	Second author + colleague
Analyzed by	First author	Second author
Respondents	Solutions provider Service engineers Product managers Marketing managers Field service experts N = 14 Customer companies Plant managers Maintenance managers Analysts and experts N = 15, four companies Internal customers Mobilization managers Area operations managers Sales engineer Plant managers N = 7	Solutions provider After-sale manager Service manager Control systems manager Technical developer N = 4 Customer companies Service managers Maintenance managers Maintenance engineers Analysts and experts N = 17, three companies

Table 1. Case study details

Analysis procedures had some case-specific differences as the cases were compared after the primary analysis round. In the EngineTech case, the researcher wrote write-ups from groupings of interviews based on

interviewee roles, and in the PowerDrive case the researcher made company-level write-ups. These were then compared by looking at similarities and differences, and by distinguishing categories of findings. The analyses followed the basic method for comparative, theory-building multiple case study (1989) and (Glaser and Strauss, 1999; Miles and Huberman, 1994). Both companies received preliminary versions of their research reports with oral presentations, but only minor corrections were suggested, indicating that a fair level of credibility, validity and authenticity of the research was achieved, as recommended by Miles and Huberman (1994, p. 278).

6. Comparing cases

6.1 History of the case solutions

Both companies wanted to further exploit their core expertise gained from designing and manufacturing high-technology capital goods. Their decisions to provide solutions were made at the strategic level, ensuring top-management support. A long history of technical development leading towards remote service solutions was traced prior to decision making.

Initially EngineTech offered stand-alone maintenance management systems as a complementary "value-adding element" to its capital good offerings. Combining maintenance operations data with product data allowed the customer to improve the coordination of maintenance activities. Clients understood the value but many of them were reluctant to pay for the offering. Some customers bought the system in order to manage their installed base, indicating that they perceived value in the system and its information content; some received the system as a bonus for large orders. However, the program suffered from persistent technical and organizational problems, creating pressure for improvements. As remote monitoring technologies became available, EngineTech recognized the business opportunities in the life-cycle of their installed base. The development described here was extended in time; several versions and upgrades of the program and the offering "bundle" were on the market, which made the whole situation "messy". Yet EngineTech had high-level maintenance expertise – much more advanced than the average customer skills – and therefore wanted to solve the problems and clarify the idea of their maintenance management offering.

At PowerDrive, the situation was more straightforward. Their experience of hydraulic motors was viewed as a valuable foundation for

preventive maintenance, and in 2000 PowerDrive developed a remote diagnostic system enabling condition-based preventive maintenance. The need for further expertise was recognized, and the development process took on an explorative nature. The business offer was developed in parallel as the system was installed in several motors to gather data and to develop analysis methods. PowerDrive promoted the solution's strengths in detecting failures, planning maintenance, and in backing up field service visits and troubleshooting, but sold fewer contracts than expected. Therefore, PowerDrive was mainly using the system for its own purposes; the offering did not seem to meet customer needs.

6.2 The solution offering

Here, we first explain the utility aspects of the studied solutions and then compare the offering structure. PowerDrive implemented real-time monitoring to find early signs of motor problems. This system improved preventive maintenance, as observed, actual needs were taken as the basis of planning instead of estimations: the monitored parameters allowed extended analyses of machine performance. EngineTech already had a maintenance management program in the market, but customers did not use their maintenance data effectively. EngineTech wanted to extend to real-time monitoring, analyze the data, and plan and manage maintenance accordingly for the customer. Thus, their maintenance management was a combination of planned and predictive maintenance.

The developed solutions shared a rather similar component structure (Figure 1). Thus, we propose that such structure might serve as a skeleton framework for integrated solutions for capital goods maintenance. The basic solution included four types of offering components:

1. the installed base, i.e. the capital goods as the object of the service;
2. the solution system platform;
3. information offerings; and
4. service components.

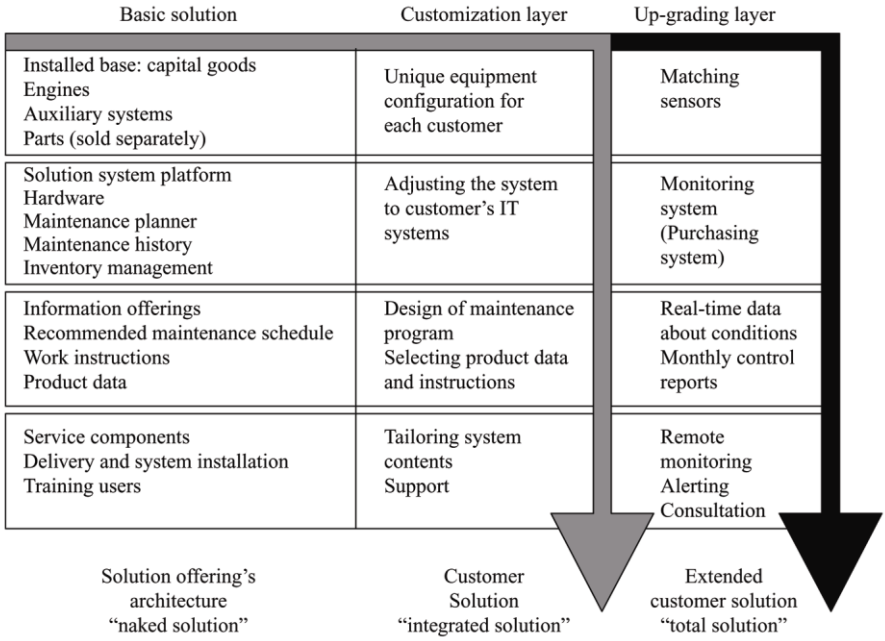

Figure 1. A skeleton framework of the solution offering structure, with examples from the cases

The idea of basic solution is close to the concept of "naked solutions" introduced by Anderson and Narus (1995): it defines the product architecture of the solution, but needs to be adapted and applied in customer specific conditions to take the shape of an integrated solution. This applied and deliverable version of the offering may be called the customer solution to differentiate it from the generic product platform of the basic solution. Some capital goods might allow standardized off-the-shelf product-service hybrid offerings, but installed bases such as manufacturing equipment tend to be complex customer-specific configurations. For instance, during customization the specific work instructions are chosen to match the design of the customer's equipment. The customer solution should thus solve all the needs related to the targeted process of a specific customer at the agreed level.

To increase business, solution providers continuously develop additional features for the basic offerings. In the cases, the remote real-time monitoring was a feature that provided access to further features, which in turn exploited the generated data and the technical experience of the providers. In addition, EngineTech developed a purchasing system module for the maintenance management program; PowerDrive's products were not as complex and spare-part purchasing was handled manually. PowerDrive developed SMS-alerting as an

upgrading feature. Thus, the upgrading layer allows the addressing of a broader variety of customer needs with one basic solution architecture.

The value proposition of both solutions is that optimal maintenance, enabled by condition-based maintenance management, yields the highest total value. Costs are reduced by optimizing the relation between the usage life of parts and the likelihood of failure. Naturally, minimizing downtime maximizes operations uptime and efficiency. In most organizations, maintenance must be negotiated between planned and monitored maintenance needs and operations needs. The manufacturers' expertise, enacted partly through consultation, facilitates the customer in improving its practices and resource structures in relation to production. When combined, the different parts of the system yield the most effective maintenance management approach, thus influencing the total costs. Thereby the systemic argument, that a solution offering provides more value than the sum of its parts, is supported by these case studies.

6.3 Problems in delivery

We now look at the delivery and production of the promises and offerings described above. Although both case companies have a reputation for high quality and being in the forefront of technical development in their traditional product lines, several critical failure points relating to the technical competence were identified in both firms. EngineTech's solution struggled with several stand-alone systems requiring manual handling of data between systems. This problem concerned both the solution system platform itself – causing some customers to abandon the system – and the internal processes of producing the customer-specific solution. To fix this, EngineTech developed automated tools to manage information both internally and externally.

PowerDrive reported failure peaks and shortened component lifetime when customers overloaded the motor; EngineTech's equipment became unreliable, or their service need increased, because the fuel available in some areas did not match the standards, or the equipment was used irregularly instead of continuously. In such cases the pre-planned maintenance management programs were inappropriate. Furthermore, EngineTech had severe problems as its field technicians could not fix those problems of a systemic origin (i.e. resolve the misfit between equipment design and conditions):

> *[. . .] with EngineTech engines, when we hit the button, we don't know if they are going to start or not [. . .] they analyze it, they do [. . .] it takes a long-time to get it right. [. . .] Well, in a lot of places they run 24 hours, all around the clock [. . .] But [. . .] it's more*

beneficial [for us], cost wise, to run them for a certain time and shut them off, and that's basically what we are doing now. And I feel that if we ran them all-year round, 24 hours, some of the problems we are experiencing would kind of go away (operations manager and customer plant).

In addition, the field technicians did not use the maintenance management software, leading customers to question its value, and eventually reducing the credibility of its technical competence. This was interpreted as pointing to the need to establish internal practices for the use of the solution tools in all the various related business activities of EngineTech.

In both companies, the solutions development was mainly carried out by technical staff within the after-sales service unit. PowerDrive's developers did not perceive the new solution as different from the pre-existing services, and concentrated on technical matters. EngineTech's development staff focused on the information system instead of service aspects. Customer solutions were perceived as installation projects, leading to problems in customer interface (lagging schedules in some customer projects, reduced support service quality due to lack of expert time) as no resources were allocated for continuous customer support after completing the installation. This was resolved through better conceptualization of the offering and its service components. The sales organizations of both companies were confused about the benefits of the solution and avoided promoting it. Clearly, development was more technology – than market-oriented: neither company had even defined its target group. The situation was improved through segmentation efforts and focusing on the creation of marketing materials. Also, commissioning researchers to intervene in the situation indicated readiness for change.

EngineTech was left in an awkward situation, as its software supplier was unwilling to improve the platform which lacked automated data processing tools and was laborious to use. The customers' motivation often faded before the benefits requiring long-term use of the system were achieved. Smaller customers could not afford the price of the solution or were unable to allocate enough staff to the laborious process, although they perceived the acute need for a maintenance solution. Finally, the conflict was resolved as the software supplier was acquired by another firm which was interested in co-developing the technical platform.

Both companies suffered from the lack of business intelligence tools in managing their solutions business. EngineTech was unable to determine the cost of producing its services, because its accounting

systems and monitoring policies were designed for physical product sales. It consequently started a major renewal of the information system infrastructure. For EngineTech, fragmented customer information caused problems like the shipping of incorrect parts, due to outdated information about the design of the installed base. Customer orientation was weak. For instance, feedback from customers was not proactively gathered, leading them to perceive EngineTech as a company lacking interest in its customers. At PowerDrive, a technician installed the system at the customer plant without providing the customer any information about it. Often the system was simply delivered or handed over, instead of being used as a resource for collaborative purposes:

> *EngineTech should check how we feel about the program but they were never interested (operations clerk and customer plant).*

> *We are not high up on the learning curve, but [. . .] We are struggling, though we're getting there. And I think it could be made a lot easier by EngineTech – being a little bit more co-operative and being aware of some of the problems (maintenance manager and customer plant).*

Sometimes lack of trust between the provider and its clients prevented successful collaboration. EngineTech needed to protect its technology from competitors, consequently not fully trusting its customers. This was perceived by the customers, as EngineTech provided them information scarcely or limited their access to it. EngineTech suspected that its customers abused warranty contracts, whereas the customers felt that EngineTech was following its own opportunistic agenda. However, some respondents at EngineTech argued that the technical product data were no longer strategic information in the new solutions-focused context, and that broadening the customers' access was crucial.

Although PowerDrive did not suffer from mistrust, their customers also stressed the necessity for open and trustful collaboration, as unexpected questions of responsibility might occur despite the solution. When the sales organization expressed uncertainty about responsibility in the case of motor failures, PowerDrive refused to take responsibility for undetected errors. However, customers interpreted preventive maintenance as a shift of responsibility, and the sales department requested resolution of this before the solution could be launched successfully. A well-functioning, collaborative relationship including defined roles and responsibilities clearly is a prerequisite for integrated solutions.

Continuing traditional sales practices, both firms focused strongly on closing deals with the result of little attention being paid to selecting the best equipment type in the long run. This situation could be improved by restructuring incentives. Lack of collaboration between product development and service staffs was obvious at EngineTech, because reported problems did not promptly lead to improvements in engine design: the product development professionals overlooked the practically-oriented field technicians as a possible source of innovation. Things were different at PowerDrive, as its product development division early recognized the potential to generate field knowledge of the products in use.

The failures and problems reported here could have been avoided through better integration. In the case analysis, we identified two levels of integration: basic-level integration is required between the components of the solution offering: coordinating the different components of the solution, tailoring the maintenance programs to customer's conditions, and the required seamless and reliable co-functioning of both physical products and services. Higher-level integration takes place between systems: the customer's business systems as the broader system and the provider's system as the subsystem.

6.4 Understanding the customers' business systems

Both firms have customers in different industrial sectors worldwide, meaning that conditions for the business processes vary between sectors, locations, and individual customers. The customers emphasized the obvious criteria of solutions to fulfill their needs, but to be worthwhile the collaboration must offer more benefits than customers can create on their own, and decrease their risks, using in-house operations as the reference point. Different components of the solution were not always considered equally useful:

> *That maintenance part [. . .] it's a real plus for that system, the way it generates the work orders, the way you report back what is done, it's a really nice system [. . .] The inventory part of this system, that's gonna be more difficult. We don't have anybody, a particular job instruction for it, we don't just take a person and say you're going to be doing all the inventory here [. . .] (operations manager and customer plant).*

An important factor is each customer's experience of maintenance. A customer of PowerDrive with long experience in preventive maintenance and remote monitoring would not gain added value from the offering and was therefore unwilling to share information. This conflicts with the idea of remote monitoring in which data are literally

transferred between the customer and the remote centre. Another customer valued PowerDrive's expert knowledge, but had concerns about the technology embedded in the solution. They wanted to increase PowerDrive's responsibility for maintenance operations – not just remotely:

> *Maybe PowerDrive could take responsibility for all hydraulic equipment in our plant [. . .] we want to focus and cooperate with good partners (service manager and customer plant).*

However, another PowerDrive customer perceived reluctance to share risks:

> *The manufacturers are really cowardly. They are so afraid if anything goes wrong. If they could promise us reliable diagnoses it would be valuable, but they are so scared. Instead, we have to take the risk (preventive maintenance manager and customer plant).*

In both cases customers requested concrete examples and calculations to convince them and to help determine the generated value and associated risk. Internal customers of EngineTech argued that not enough data were available to estimate the productivity of the broader operations services offering. EngineTech's external customers were more convinced about the solution – perhaps success in full operations contracts served as proof of the company's ability to carry the risk.

7. Concluding discussion

To produce solutions that address customers' needs requires understanding of their business processes as well as evaluating offerings and competences from the customers' perspective. Both PowerDrive and EngineTech approached solution-offering development from the technical side, failing to properly address different customer needs and preferences. In the customers' eyes they did not show commitment and customer orientation, and were unaware of the opportunistic nuances of their decisions. We see the perceived problems as pointing to a mass production orientation in the case companies. Mass production oriented thinking aims at developing off-the-shelf products, multiplied to achieve economies of scale. The value capturing logic emphasized the point of sales instead of continuous joint production, and services focused on supporting the installed base, rather than the broader system around the equipment. Clients were assumed to follow a common industry-specific business model, but in reality the equipment was utilized in differing business models, which required alternative designs of maintenance programs. The provider thus has to look beyond the installed equipment

– to its usage patterns and organizational context. Instead of segmenting clients based on their engine type, the solutions orientation requires increased customer-specificity and consideration of customers' business strategies. The gains accrue incrementally in the long run through joint operation and shared goals. Moreover, providers need to pay attention to the duration of operations and especially keep in mind the continuity of some service components in solutions. Companies may be unaware of the ripple effects upon their productivity when solution offerings are delivered as CoPS installation projects.

In the area of service design, operations management has focused on the question of decoupling/coupling of tasks between the front office, i.e. the customer interface, and the back office (Zomerdijk and de Vries, 2007). Taken to the context of integrated solutions, in which the main parts of the process happen inside the client's business system, the idea of improving efficiency by locating most tasks in the back office is simply inadequate. This indicates an urgent need to develop service operations management approaches that support the design and management of co-productive service processes produced as part of the customer's operations.

Customers interviewed in this study generally emphasized risk reduction over cost-savings. The shift of technological and operational risks to the provider is an important value-generating mechanism of maintenance solutions. The customer carries the market risk associated with its business and pays a premium to the provider for sharing other risks. The provider is expected to improve operations further, to the extent that savings may be achieved in the total costs (despite the premium). Customers' evaluation of the integrated solution goes beyond the utility aspects: they become tied to a certain tangible technology as well as to the provider, and hence they evaluate the provider's capability to deliver the promise over the long-term. Our interpretation is that some customers were unwilling to buy solutions not because of the solution offering itself but because of the associated risks, and their doubts of the provider's capabilities to act for the true benefit of the customer, or to take responsibility.

In addition to a well-defined and technically developed integrated solution bundle, selling solutions depends on trust and credibility. By trust we mean the perception that the provider is playing in the customer's team, not against the customer (and vice versa). By credibility we mean customer's evaluation of the provider's capability to deliver the promise. Manufacturers aiming at solutions business need to improve trust issues already in their more traditional businesses and to establish a

reputation that encourages interdependence, while credibility can be improved through pilot cases and making promises well-defined, guaranteed, measurable, and charged based on outcome.

Integration is not just a phrase to sell the idea of full service to clients. It is a necessity even for the provider to be able to deliver solution offerings, i.e. to fully solve a need in relation to a specific function or task in the client's business system. Integration needs to be addressed (at least) at two levels: in the basic level of the offering and the provider firm, and in the higher level between the solution subsystem and the external system of the client. By the term "systemic" we mean that the components of integrated solutions are interdependent, and integration refers to co-design and management of the different subsystems within the solution offering.

Much of the literature on integrated solutions emphasizes uniqueness and customization (Davies, 2004; Galbraith, 2002; Shepherd and Ahmed, 2000), while ideas vary on how this is achieved and where in the integrated solution it is located. Too much customization may complicate the business, leading to operational problems reflected in the credibility of the value proposition. Drawing on the cases, we suggest a layered view of solution offerings in which a basic structure and the customization aspects are separated, and major service level up-grades form their own layer. Moreover, we suggest conceptualizing the offering through the types of the core components, to ensure proper organization and operational support. This, still very crude, structural representation improves the earlier approaches which distinguish solutions as combinations of services, software and hardware (Shepherd and Ahmed, 2000); as services, goods and information or knowledge (Cornet et al., 2000; Wise and Baumgartner, 1999); as a set of capabilities (Ceci, 2005; Cornet et al., 2000; Davies, 2004); or as a combination of core capability and supplementary services (Davies, 2003a).

Both case firms had unique expertise gained from manufacturing and field service business, and their products were known for their superior technical quality. Top management supported the new approach in both firms. Yet the development of integrated solutions encountered problems. Earlier research has described success stories (Davies, 2004) as well as challenges encountered by case firms (Brax, 2005; Gebauer et al., 2004; Windahl et al., 2004). When challenges are discussed in the existing literature, they tend to be demanding tasks which firms need to conquer in their still relatively straight-forward road to solutions business (Cova and Salle, 2007, pp. 142-3). The notion that becoming a solutions provider is challenging seems to point to the fact that it is laborious. The

contribution of our cases is that they give a snapshot of the real-life in manufacturing firms trying to resolve the complexities encountered in creating an integrated solutions business. First, the study shows that even the successful cases involve pervasive challenges in the development stages. Second, it shows how contextual and complex a development process of integrated solutions can be. Thus, it questions the straight-forward process approaches, as well as the common view of service components as easy to copy (Corréa et al., 2007, p. 448), and demands that more attention be paid to context-sensitive research of the development processes of integrated solutions.

Earlier research has identified the building of the service culture and understanding customer needs as the most challenging tasks perceived by service managers (Prajogo, 2006). Thus, the finding that the case companies suffered from mass production orientation is not a surprising one (Buse et al., 2001). Earlier research has stressed the need to replace mass production orientation with customer orientation and become more customer focused (Davies, 2003a; Galbraith, 2002). However, what does customer focus mean? Becoming more flexible, more proactive towards customers' needs or perhaps choosing customized designs built-to-order as the main product strategy? Customers primarily expect solutions to match their needs and to function reliably (Ceci, 2005), not customization per se. An important finding from the case analyses is that there was no single cause for the problems encountered by the firms. In addition, the problems we have described are strongly interlinked. We argue that our findings (the interdependence of maintenance programs and customer's business models), and the competences required for integrated solutions identified in earlier research (Gebauer et al., 2004; Miller et al., 2002; Shepherd and Ahmed, 2000), point towards a balanced and sustainable holistic approach. Manufacturers should thus focus on developing this further to exploit the competitive advantage gained from their technological background. Yet the technological standard must be sustained at a high level, as solutions are based on technical support systems and integration. Thus, our study suggests that solution providers cannot succeed by switching from pure product centricity to pure customer centricity; they need to find a way to become excellent in both fields. If the system fails, good service does not save the damage caused to the customer's business.

This leads us to conclude that the dynamics of solution offerings necessitates adopting a long-term systems orientation. By this we mean that development should be holistic, balanced, iterative, collaborative with the client, and focused on seeking mutually beneficial approaches

evaluated over the long haul. We invite more empirical research on how firms manage to do that. The external integration might be called "healthy interdependence". We recommend more research be done on this as well as on the internal integration within solution offerings. Since we perceive the integration taking place between the provider and the client, we think that the customer's voice has been somewhat neglected in current research. Using customer representatives as informants is essential in studying interdependence between firms.

Everything in solutions challenges the supplier to learn more about its customers. Solutions require the capability for both internal and external integration. The system orientation of solutions suggests that the provider becomes a part of the customer's system, i.e. the solution may be seen as a functional subsystem. This departs from mass production oriented thinking which sees the provider-customer collaboration as implementing a pre-designed subsystem into the client's system. The fit between the subsystem and the whole system is crucial. We emphasize that this main system is the customer's business. Existing research (Davies et al., 2006; Jacob, 2006) views integration as incorporating the customer's production factors with the solution provider's products or production system. Our study suggests that manufacturers should prepare better for managing the higher-level integration between the solution subsystem and the customer's business system. Accepting the risk of perhaps going too far, we would like to suggest a competing view: the provider integrating itself into the customer's system.

7.1 Summary of research implications

The terminology of the research area requires critical analysis – particularly the concept of integration needs to be investigated, and some theoretical support might be found in the area of systems thinking. Further empirical analyses of integration, and the theme of adding more value in the systems level than the sum of the parts, should focus on the interdependencies between the components, actors and processes – the emergent properties arise from these linkages. The wide emphasis on customer focus should lead to the increasing involvement of customers in integrated solutions research. Success and failure examples are extreme contradictions and should be used with caution as most cases fall in between, typically ending with a successful solution after resolution of a complex network of problems. This also indicates that simple, generic roadmaps to establishing integrated solutions business may not tell the whole story.

The emergence of new important perspectives related to the service aspects does not necessarily suggest that earlier ones need to be abandoned – the idea that integrated solutions consist of physical goods, services and information clearly points towards the amalgamation of several perspectives. This should be seen in the use of theoretical backgrounds as well; if these business models are hybrids of manufacturing, service business and knowledge work, then merging theory from all these areas should be cherished in integrated solutions research.

Operations researchers should start thorough empirical research about the operations that take place both in the open system contexts, which involve the client as a central actor in the process, and in the hybrid offering contexts, where the goods vs services juxtaposition becomes inadequate. Such research should then enable the development of approaches that support firms in moving to business models involving goods-services modes of working, such as in the case of integrated solution offerings.

7.2 Summary of managerial implications

Companies pursuing integrated solutions need to pay attention to the orientation and the basic assumptions under which they operate. Customer – and service orientations should be nourished, but not at the cost of losing technical product competence.

The dynamics of value creation in integrated solutions are different from the sale of goods. The continuity of the relationship and the incremental generation of profits need to be addressed carefully in designing the offering. Integrated solutions have cost effects for the customer beyond the purchase price, and value creation needs to be analyzed from the customer's perspective. For instance, the interviewed customers in these cases emphasized the value of shifting risks to the provider.

Manufacturing companies moving into service business need to understand that their production processes are no longer encapsulated within the factory walls; integrated solutions are all about implanting production processes as parts of the customers' business systems. This process is an open field for the customer to make observations about the provider – and collaborative operation cannot be based on conflicting interests. Integrated solutions providers must ensure that their operations in all business areas reflect trustworthiness and credibility to potential clients. In a collaborative production setting, manufacturers can no longer lurk buffered behind their tight warranty clauses; they need to

become more open to the different ways customers use their equipment and use this to proactively improve their offerings.

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