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Sergio Biggemann, Christian Kowalkowski, Jane Maley and Staffan Brege

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Development and implementation of customer solutions: A study of process dynamics and market shaping ☆

Sergio Biggemann [a,*], Christian Kowalkowski [b,c], Jane Maley [d], Staffan Brege [c]

[a] University of Otago, Department of Marketing, PO Box 56, Dunedin, New Zealand
[b] Department of Marketing, CERS - Centre for Relationship Marketing and Service Management, Hanken School of Economics, PO Box 479, FIN-00101 Helsinki, Finland
[c] Department of Management and Engineering, Linköping University, SE-581 83 Linköping, Sweden
[d] Macquarie University, Sydney, Australia

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ABSTRACT

A broad, dynamic network perspective on solution processes remains scarce. This article presents the process of developing and implementing customer solutions and its effects on the wider business environment by investigating customers and suppliers in the global mining industry (Australia, Chile, and Sweden), analyzing the deployment of a new customer solution, and assessing the changes to the competitive environment and focal firms' relationships with other customers and suppliers. It shows that the forces that drive customer and supplier interests and motivation to co-develop customer solutions may change over time, thus redefining the aim and scope of solutions and creating failure risks. Customers present problems; suppliers respond, on the basis of not only the feasibility of the customer-specific solution but also of their evaluation of future solutions in a broader market; then suppliers aim to standardize successful solutions across markets. Customers want close supplier relationships and unique solutions but also like standardized and repeatable solutions, so they can share development costs with competitors and expose the supplier to competition to avoid lock-in effects. From a network perspective, a novel solution can have a market-shaping effect and evoke reactions from other actors who want to enhance their market position. However, these changes are not necessarily deliberate, and the dynamics that market introductions of solutions trigger may be difficult to predict.

1. Introduction

In the past decade, research on business solutions in the field of business-to-business marketing has expanded remarkably, reflecting the significant shifts in business development and marketing practices across industries. As competition increases and customer needs become more extensive, product firms seek to differentiate themselves by providing customer solutions rather than stand-alone goods or services (Davies, Brady, and Hodbay, 2006; Nordin and Kowalkowski, 2010; Spencer and Cova, 2012; Ulaga and Reinartz, 2011). In recent conceptualizations, customer solutions constitute goods and service components integrated together into customized combinations, which in turn are embedded in longitudinal, relational processes between the business customer and supplier (Cova and Salle, 2008a; Hakanen and Jaakkola, 2012; Storbacka, 2011; Tuli, Kohli, and Bharadwaj, 2007).[1] This view of solutions as embedded in relational processes—what Tuli et al. (2007) refer to as a process-centric view—not only contrasts with extant product-centric perspectives (e.g., Chae, 2012; Davies et al., 2006; Galbraith, 2002; Matthyssens and Vandenbempt, 2008; Sawhney, 2006) but also enables a more in-depth understanding of the nature of solutions processes. However, in their review of solutions literature, Nordin and Kowalkowski (2010) note that research on the development and implementation of solutions remains scarce. Few studies investigate distinct solution process stages (Aarikka-Stenroos and Jaakkola, 2011; Brady, Davies, and Gann, 2005; Davies, Brady, and Hobday, 2007; Tuli et al., 2007); frequently, they tend to adopt limited views of solutions as linear (e.g., Ceci and Prencipe, 2008; Sawhney, Wolcott, and Arroniz, 2006). Inherently though, solutions are responses to customer problems, and if the problem is complex or ill-defined, such limited views become inadequate. Problem solving requires an iterative, less identifiable solution process (e.g., Amabile, 1983; Hershey and Walsh, 2000).

* Corresponding author. Tel.: +64 3 479 8467; fax: +64 3 479 8172.
E-mail addresses: sergio.biggemann@otago.ac.nz (S. Biggemann), christian.kowalkowski@hanken.fi (C. Kowalkowski), jane_maley@hotmail.com (J. Maley), staffan.brege@liu.se (S. Brege).

[1] We use the term "customer solution" herein; other authors refer to business solutions (Dunn and Thomas, 1994), integrated solutions (Davies et al., 2006), market solutions (Spencer and Cova, 2012), and process delegation services (Ulaga and Reinartz, 2011) to denote similar concepts.

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Previous conceptualizations of customer solutions also tend to ignore the effects of solutions once implemented. In the extant view, the process ends with the customer-centric outcomes, which might range from solving a customer's problems (Sawhney et al., 2006), to satisfying a customer's business needs (Tuli et al., 2007), to enabling the customer to achieve "peace of mind" (Woodruff, 1997). These dyadic approaches—including Tuli et al.'s (2007) reconceptualization of solutions as relational processes and Nordin and Kowalkowski's (2010) critical review and analysis—forget though that "a solution situation is not a buyer-seller dyadic 'island'. It is multi-partite and not isolated from the 'rest' of the market" (Spencer and Cova, 2012, p. 1582). Spencer and Cova (2012) call for a broader approach to markets and market dynamics, beyond the customer–supplier dyad. In this sense, solution effects are not limited to customer value outcomes but also may influence other market actors and even shape the market (e.g., Corsaro, Ramos, Henneberg, and Naudé, 2012; Storbacka and Nenonen, 2011). That is, the effect that a solution has on the customer–supplier relationship can influence other relationships too and thereby affect how competitors (i.e., other customers and suppliers) act (Håkansson and Ford, 2002). Among studies that go beyond the focal dyad, Hakanen and Jaakkola (2012) and Jaakkola and Hakanen (2013) investigate multiple suppliers involved in implementation. Spencer and Cova (2012) note the effects on competitors, but their primary data are limited to the focal customer and supplier firms, which they acknowledge as a limitation.

This discussion highlights the need for further research on customer solutions; most researchers study this phenomenon from a firm-centric or dyadic perspective only, without achieving an in-depth understanding of how customer solutions evolve. To fill this research void, we study the process for developing and implementing customer solutions and its effects, beyond the focal customer–supplier dyad, by exploring the real-world involvement of multiple parties who co-define the problem, co-develop the solution, and, effectively, co-create value.

Our investigation centers on customers and suppliers in the global mining industry, in which context we analyze the development and implementation of a new customer solution and its effects on the competitive environment. With this approach, our study makes several contributions. First, it provides in-depth, case-based insights that reveal the dynamic, emergent nature of processes for developing and implementing solutions in competitive environments. Second, we describe how the interests of the parties, within the dyad and beyond, might change during the solution process, and how such shifts affect the problem definition and thus the scope of the solution. Third, this study advances market-shaping and business networks theory by detailing the interconnectedness of actors who behave in a particular way to achieve specific effects, some of which are intended and foreseen, and others which are neither foreseen nor intended. Introducing a customer solution may spark changes in competitors' activities and alter the competitive environment. However, these changes are not necessarily deliberate, and the network effects of a market introduction may be difficult to predict.

2. Conceptual background

The history of customer solution marketing and selling can be traced to the early 1960s, with the emergence of the systems selling concept[2] (Cova and Salle, 2007), which combined products and services to fulfill extended customer needs (e.g., Hannaford, 1974; Mathews, Wilson, and Backhaus, 1977; Mattsson, 1973; Page and Siemplenski, 1983). Cova and Salle (2007, p. 143) summarize the common characteristics of project marketing and customer solution marketing: "no pre-fixed offer, no demand systematically taken literally, but the possibility thanks to the intimate relationship with the customer, to anticipate and thus to be able to co-create the project/solution." A customer solution approach resonates with Treacy and Wiersema's (1993) customer intimacy concept and requires high depth and high breadth in the interaction. An in-depth interaction puts the customer's problem into context and implies a high degree of interconnectedness throughout the solution process (Windahl and Lakemond, 2010). The breadth of the interaction implies both an enlarged buying center and an expanded selling center, affecting the focal networks of both parties (Cova and Salle, 2007). Furthermore, recent conceptualizations of customer solutions recognize the need to consider the broader business network and other parties that potentially influence (or are influenced by) the customer solution (Cova and Salle, 2008a; Gebauer, Paiola, and Saccani, 2013; Spencer and Cova, 2012; Windahl and Lakemond, 2006).

The antecedents of customer solutions also vary across industries and market actors; Nordin and Kowalkowski (2010) identify several external and internal drivers of the wider adoption of solution marketing. For example, commoditization propels the adoption of customer solutions as a means of differentiation. Commoditization implies increased product homogeneity, higher price sensitivity, lower switching costs, and greater industry stability (Reimann, Schilke, and Thomas, 2010), as exemplified by increasing low-cost competition and saturation in product markets (Davies, 2004). Commoditization erodes competitive differentiation, decreases technology and product lifecycles, and often leads to a profit squeeze (Matthyssens and Vandenbempt, 2008; Shepherd and Ahmed, 2000). In addition, cost reduction, flexibility, and risk aversion are major reasons customers outsource non-core functions to suppliers (Nordin and Kowalkowski, 2010). Furthermore, as information and communication technology (ICT) enables emerging services and service processes (Kowalkowski, Kindström, and Gebauer, 2013; Rust and Thompson, 2006), the possibilities for new solutions increase. Providers thus offer new solutions, explicitly linked to customers' output (e.g., availability, performance) that compensate the provider on the basis of the customer's value-in-use (Storbacka, 2011; Ulaga and Reinartz, 2011). Many modern suppliers accept responsibility for customers' processes (Kujala, Artto, Aaltonen, and Turkulainen, 2010); because manufacturing companies have deep knowledge of their products and markets, they often are well positioned to offer customer solutions (Knecht, Leszinski, and Weber, 1993; Mathieu, 2001; Ulaga and Reinartz, 2011).

Solutions thus might reduce competition, strengthen customer relationships (Nordin and Kowalkowski, 2010; Tuli et al., 2007), increase the share of wallet or deal size, and enable firms to access new markets (Krishnamurthy, Johansson, and Schlissberg, 2003). Hahn and Morner (2011) argue that when entering the solutions arena, companies acquire more revenue and can better differentiate themselves from their competitors. Whereas products and basic services are easy for competitors to emulate (Vandermerwe, 2000), solutions are difficult to imitate and thus could become long-term sources of competitive advantage (Matthyssens and Vandenbempt, 1998; Shepherd and Ahmed, 2000; Storbacka, 2011). Against this backdrop, it is important to further understand how customers and suppliers can successfully co-develop and adopt solutions.

Most research proposes sequential processes to describe the development and implementation of customer solutions. According to Sawhney (2006), the solution development process begins with the analysis of a customer problem—defining customer outcomes and mapping customer activities—and ends with the identification of products and services needed to solve the entire problem, before moving on to the integration (implementation) stage. Aarikka-Stenroos and Jaakkola (2011) specify five stages: diagnosing needs, designing and producing solutions, organizing the process and resources, managing value conflicts, and implementing solutions. Storbacka (2011) proposes a four-stage process to create customer solutions: develop solutions, create demand, sell solutions, and deliver. Similarly, Davies et al.'s (2007) four-stage process consists of the following: provide an in-depth analysis of a customer's business,

[2] Although the genesis of the systems selling concept is not well established, according to Mattsson (1973), the concept first appeared in a trade journal article by Murray (1964).

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identify and diagnose problems, offer solutions based on experience working with customers facing similar situations, and coordinate the integration of components into a solution. Moving beyond a product-centric view, Tuli et al. (2007) propose a process-centric view of solutions comprising four distinct phases: requirement definition, customization and integration, deployment, and post-deployment support. Although this latter conceptualization includes both the supplier and customer perspectives and presents the process as sequential, it says little about how companies transition from one stage to other. Furthermore, most research discusses customer solutions in the context of the delivery of a single solution. However, Storbacka (2011) recognizes the need to create repeatability of solutions, which is in line with Davies and Brady's (2000) view that succeeding solutions should be possible to deliver at significantly lower costs than the first solution. By taking a broader view on the development and implementation of customer solutions when parties interact to co-create an outcome superior to previous offerings, we aim to derive further insights into solution processes.

3. Methodology

Investigating the process of solution development and implementation, and its effects on multiple actors in the network, is a complex and context-bound pursuit. Therefore, we used a qualitative case study approach, which can offer insights of high accuracy and substantial complexity, reflecting organizational and individual processes (Woodside, 2010). Case study research generates richness and depth of understanding; it is particularly useful for increasing understanding of previously under-researched issues (Gummesson, 2000), such as customer solutions processes. Lincoln and Guba's (1985) case study structure presents the problem, the context, the issues, and the lessons learned, which is an effective approach to answering the research questions. Our data also are consistent with Creswell's (1998) recommendation that case studies address systems bounded by time and place and Yin's (2003) requirement of contemporary events for case studies.

The global mining industry we study provides an interesting solution context for several reasons. First, currently intense investments in old and new mines create more opportunities to sell solutions. Second, mining demands intensive maintenance, and production interruptions are very costly (Kumar and Kumar, 2004). Thus suppliers have opportunities to sell solutions that reduce high maintenance costs or increase equipment availability to a currently installed base. Third, the rapid expansion of the global mining industry has led to shortages of, and cost increases for, skilled labor and equipment. Such resource shortages increase demand for labor-efficient operations and outsourcing alternatives, which in turn establishes favorable settings for suppliers offering solutions that can reduce mining companies' demand for personnel. Fourth, the high volatility of commodity prices may encourage mine operators to counter volatility by seeking flexible, predictable cost solutions. Analysts suggest volatility is due to fundamental supply/demand imbalances, such that the industry is experiencing an ongoing shift toward high volatility environments (Connoly and Orsmond, 2011; Louie and Burton, 2011). Fifth, the principal researcher has long experience working with this industry and possesses both extensive knowledge of mining operations and close contacts with decision makers.

3.1. Case selection and data collection

To ensure a rich context that enhances data relevance (Lincoln and Guba, 1985), this research was conducted in Sweden, Australia, and Chile. Sweden is the home of some of the most important brands of mining equipment; Australia and Chile host large mining projects and mining companies. Five leading mining industry suppliers with headquarters (and/or other key functions) in Sweden were selected using theoretical sampling (Eisenhardt and Graebner, 2007; Silverman, 2006). The Swedish mining industry consists of two major mine operators and many suppliers, which meant we could investigate almost every major company and increase the probability of finding case studies relevant to our research aims. We also were able to assess the state of existing solutions in the mining industry relatively accurately. In turn, we approached local branches of the same companies in Chile and Australia. The selected suppliers had to maintain business presence in all three countries, offer customer solutions, and differ enough from one another to allow for sufficient variance in their customer solution experiences. In the following descriptions of the participants, we changed all the supplier company names to protect their confidentiality.

Arvika is a large producer of equipment for the mining industry, with annual sales in excess of $10 billion. Its factories span 14 countries and sales companies appear in 80 countries around the globe. Among Arvika's products are rock drilling rigs for underground and open pit mining, trucks, scooptrams, air compressors, and rock drilling tools. Despite its numerous factories, Arvika construes its identity as a marketing company. Ludvika, though similar in structure to Arvika, began as a steel manufacturer but extended its offerings in the late 1980s by acquiring other firms, most of them Arvika's competitors; Ludvika still regards itself as a manufacturer. However, its product range is similar to Arvika's, and the companies are approximately equivalent in their large sizes. Kumla manufactures and markets equipment for mineral processing, with subsidiaries in more than 20 countries. Skara is similar to Kumla, but though it maintains a large office in Sweden, its headquarters are in Finland. Finally, Kallax is a $50 billion company that specializes in energy production and automation. It has manufacturing facilities in 7 countries and subsidiaries in 100. Representatives from Skara and Kallax were interviewed in Sweden, but we were unable to engage these companies in Australia and Chile. In contrast, for Arvika, we gained access in Australia and Chile but not in Sweden. Overall, the sample includes a wide spectrum of mining industry suppliers, which provide similar offerings but different cultures and serve similar customers but address different needs.

We employed various strategies to avoid the pitfalls of qualitative enquiry, especially related to validity and reliability (Foddy, 1993). We gathered our data through semi-structured interviews with suppliers in three countries, using a snowball method to identify participants (Goodman, 1961; Salganik and Heckathorn, 2004). That is, suppliers noted customers with which they created solutions. During the data collection, we realized that when we focused on a particular case, respondents could better explain their thoughts about customer solutions. At the end of the interview, we requested the names of people and organizations related to the case; with the respondents' help, we then arranged new appointments with customers, who also were briefed about the research objective (i.e., to understand the creation and implementation of customer solutions). Customers tended to focus on the same case that the suppliers initially discussed, because they were aware of the reason they had been approached. Next, we conducted interviews with four key customers. As Table 1 details, we conducted a total of 28 interviews. Incidentally, all three suppliers in Australia mentioned Mareeba as a customer with information about the creation of solutions; however, Mareeba worked with each supplier on a different problem, leading to different customer solutions in each case.

To obtain these interviews, we requested appointments with CEOs in Sweden and managing directors in Australia and Chile. Considering the variety of definitions of customer solutions, we opened the research to diverse types of customer solutions and explained our research purpose briefly, to secure access. In the interviews we sought to understand the process of customer solution creation and implementation; we did not offer conceptual descriptions of customer solutions to participants, so that they could elaborate on their own views. Yet we still prepared a list of probes, in accordance with existing knowledge, to ensure that the discussion included key topics, such as processes for developing

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Table 1
Interview summary.

Country	Suppliers	Position of informants	Customers	Position of informants
Australia	Arvika	Managing Director	Mareeba	Innovation Manager
	Ludvika	Vice President Sales; Managing Director	Mareeba	Innovation Manager; Operations Manager
	Kumla	Head of Market Area	Mareeba	Innovation Manager
Chile	Arvika	Managing Director; Senior Manager Business Development; General Manager CT Operations; Service Manager	Talca	Director
	Ludvika	Vice President Marketing	Cunco	Director
	Kumla	Sales Manager		
Sweden	Arvika	Global Projects Manager; Application Specialist #2		
	Ludvika			
	Kumla	Vice President Business Communication; General Manager; Commercial Manager		
	Skara	Sales Manager	Yungaburra	CEO; Purchasing Manager
	Kallax	Vice President Head of Mining	Tolga	Strategic Purchaser; Technical Manager

and implementing customer solutions, value co-creation, and the role of relationships. Interviews were tape recorded and lasted an hour on average. Different researchers conducted interviews, according to their location, but all respondents were guided by the same set of probes—though less structured than an interview protocol, they offer an efficient means to ensure that the different researchers covered all the main topics (e.g., what processes do customer solutions follow, who initiates contact, how is the problem defined, is the scope of solutions predefined, what is the role of different parties in developing the solution, does the supplier actively aim to offer solutions, who pays for solutions, how is solution priced?). The principal researcher visited all three countries and conducted some interviews with the resident researchers but did not conduct all interviews in person.

3.2. Data analysis

Interviews were analyzed with the help of NVivo 9, to code the transcripts of the interviews. An initial framework emerged, in accordance with Tuli et al.'s (2007) findings. The principal researcher listened to the full record of each interview. In a second coding round, passages paired with Tuli et al.'s four-step solution process model provided the initial coding structure, but we also included other, theoretically grounded codes extracted from extant literature, such as value co-creation (Aarikka-Stenroos and Jaakkola, 2011; Hahn and Morner, 2011), variable pricing (Flaxer, Cao, Tian, Ding, and Lee, 2007), network architecture (Mason and Spring, 2011), and causes of failure (e.g., cost saving mirage, lack of understanding, lack of competence; Shi, 2007). These constructs are among the most common topics in existing customer solutions literature, so we relied on them to provide the initial codes for analyzing the data. After the initial coding, some uncoded interview passages remained that did not relate to any of the theoretically grounded codes; they became the sources of the data-grounded codes. We applied the same procedure for all interviews and analyzed them in the order in which they were conducted, within each case study. This approach helped keep the researcher's mind clear and focused on one case at a time. After we coded all interviews related to one case, we repeated the process for the other cases. (A case is defined as data related to one supplier and the customer solution that its representative described in the initial interview.) To enhance the relevance and credibility of the collected information, we triangulated the interview data with information on companies' websites, compared their communication about customer solutions with their actions when dealing with clients, requested both externally exchanged and internal documents related to the creation and implementation of customer solutions, and avoided sharing any information provided in previous interviews with new respondents. These steps increased the data richness and reliability.

After completing each within-case analysis, we initiated a cross-case analysis, looking for similarities and divergences across cases to find common patterns of development in customer solutions. Some codes appeared redundant; in the light of more evidence, we recoded some passages. Although all the firms stressed the importance of offering customer solutions in their marketing communications, the views that the executives expressed about this importance varied. The Sales Vice President (Sales VP) of Ludvika in Australia noted, "Well … I suppose we have solutions, but ultimately what we sell are a bunch of machines that do the work that customers want." In contrast, the Managing Director (MD) of Kumla, also in Australia, vowed, "We aim to provide our customers with the most cost effective solution to their needs…," and the MD of Arvika in Chile stressed, "If we would not be able to offer the most cost effective solution, our permanence in the market would be questionable." Recall that Arvika and Ludvika are similar, in that they both manufacture equipment for mining purposes, but Ludvika seems less concerned about solutions than Arvika. Kumla is a different type of supplier, in that it provides mineral dressing equipment, so an approach to solutions selling appears to be the norm for its interactions with customers, for which each project is unique.

Although at first glance, the different views may appear to occur across companies (e.g., Arvika and Kumla are business solutions oriented; Ludvika is product centric), they also reflect an organizational perspective. The descriptions of Arvika's and Kumla's solutions came from their MDs—positions that encourage a strategic, long-term orientation. The informant from Ludvika was the Sales VP, who likely is more pragmatic and takes a grounded, practical approach. Using the informants' comments alone though, we could not assert with certainty what constitutes the most representative description of the companies' behavior. For example, data gathered in Chile from Ludvika's local companies contradict the claim of the firm's Sales VP in Australia that his company sells a "bunch of machines that do the work that customers want": In the past four years, Ludvika's local sales company in Chile developed an extensive customer solution with Cunco. Arvika's behavior in Chile also contradicted the views of its Australian executive, in that Arvika's Chilean branch refused to take part in solution creation, despite its strong abilities to do so, because Arvika manufactures the same type of equipment around which Ludvika developed its solution. Thus we find internal incoherence, in terms of perceptions of what is being offered, which challenges Cova and Salle's (2008a) theorizing about the structure of suppliers' value proposition. Some parts of the firm may be solution oriented, while others remain traditionally product centric. Arguably, Ludvika is more solution oriented in its Chilean office, regardless of the views of the Sales VP in Australia. Arvika's assessment of the benefits of solution offerings also appears to have changed, which could disrupt the process of operation and standardization that Cunco is planning, which would challenge Tuli et al.'s (2007) model. Yet Arvika continued to work with Cunco to develop a solution to control the operation of scooptrams

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remotely, using an open platform that also might serve to operate other equipment in other processes.

4. Mining solutions: from safety to productivity

4.1. Prologue

In this section, we detail a customer solution, developed and implemented between Ludvika and Cunco in Chile. This solution later was adopted by other customers worldwide; it also attracted the interest of other suppliers, such that it acquired international dimensions and created a foundation for new solutions. Thus, this example provides a case of successful development of a customer solution, which has spread beyond its initial boundaries and beyond the customer–supplier dyad, as well as outside the country in which it was developed. This case illustration contains elements of other cases and the reactions of parties beyond the dyad, including Arvika's views and its attempts to exploit some benefits from the new market that the solution created.

4.2. Development process

In the early 2000s, Cunco approached Arvika and Ludvika, seeking a solution to a problem: entering dangerous underground mining sites after blasting, to load rock and ore. The equipment normally used for this task is known as a scooptram or LHD (Load, Haul, and Dump), operated in underground mines by one person, which would load blasted rock and ore and transport it to an ore or waste pass before extraction to surface. Although a simple task, this dangerous step occurs after blasting, such that rocks can fall onto the equipment and cause injuries to the operator. Aware of these risks, Cunco sought solution proposals from Arvika and Ludvika that would allow it to operate the scooptram remotely, such that rock collapses would not put lives at risk. Technology to solve this problem was not available, so both companies had to assess the expected benefits and costs of developing such a solution before they accepted Cunco's invitation.

Arvika identified significant difficulties associated with remote control machinery in an underground mine (e.g., dust, moisture, vibration) and estimated that the expected benefits of a technology that could overcome these difficulties were not sufficient to offset the development cost. Thus, it chose not to accept Cunco's invitation. Although Ludvika's evaluation was similar, it was actively seeking to capture some of Arvika's market share, so Ludvika saw an opportunity and accepted the challenge—which turned out to be as difficult to solve as Arvika had expected. Remote technology was not available; radio signals do not penetrate rock, so connectivity was a persistent problem. Both parties even questioned the rationale for the project, especially as budgets got consumed and the expected time to complete the project was exceeded. Ludvika faced conflict with its main office in Sweden, and the local sales company was blamed for failing to test the technical solutions provided by the R&D division in Finland properly. On the customer side, the production manager started to resist new tests, because each time Ludvika presented a new idea, production had to be halted to run the test. Thus the project risked cancellation several times. The commitment of senior management saved the project, by reiterating the reason for initiating the project in the first place. Furthermore, as soon as some technological developments started to work, commitment to the project increased. When the results emerged better than expected, they were encouraged to extend the scope of the solution beyond its original objectives. A solution to a safety issue thus became a project with broader objectives.

Once the connectivity issues had been solved, it became apparent that the processes of hauling and dumping were routine and could be easily automated, so the scooptram operator was idle while the machine performed those processes. A new question thus emerged: Could a single operator control two scooptrams? That is, could the operator load another scooptram while the first machine was automatically performing the processes of transportation and dumping? Doing so would require operating the scooptram not only at a distance but also without eye contact. But the parties agreed that it was worth trying, so they extended the scope of the project to remote operation of multiple scooptrams with no eye contact. Potential new benefits, such as higher productivity of human resources, increased the attractiveness of this project. The potential target market also increased, which encouraged the parties to commit new financial and human resources to developing the solution.

Even before the customer solution was fully developed (much less implemented), the parties were ready to enter a new development phase, which confronted the significant challenge of finding senior management support. The project was long overdue, and threats to kill it resurged. Nevertheless, changes in the business environment provided strong rationales to continue the project. In particular, the mining industry faced shortages of qualified labor, so the prospect of increasing labor productivity was enough to keep the project alive. New trials were conducted; until the problems were sorted out, responsible staff members from both parties had to deal with internal complaints. For example, operations managers complained about the disruptions to their production schedules, and R&D staff in Finland continued blaming the sales branch for an inability to apply their recommendations, even going so far as to suggest that failures were due to cultural reasons. Scooptram operators did not offer much support for the solution either, because they perceived it would reduce the number of jobs available to them.

As processes improved and results grew more encouraging, it emerged that operators could control not just one or two scooptrams but up to five at the same time. Senior managers were thrilled. Thus, the scope of the project was extended again, to allow for operators' complete removal from the site. That is, if the operation of the scooptram could be done without the operator maintaining eye contact with the machine, the operator could sit somewhere else, not necessarily in the mine. The aim became moving operators to an office in the city, while keeping them in command of five scooptrams.

4.3. Epilogue: implementation and market response

With the ultimate solution in place, both parties started to worry about their own interests, leading to an immediate shift in their relationship. Ludvika wanted to price the solution high enough that Cunco would pay the associated R&D costs. Yet it also wanted to standardize the solution to sell it to other customers, while protecting it so competitors could not copy it. To protect its intellectual property, Ludvika used proprietary technology to create the solution, so that it was effective but did not allow for connectivity with other equipment. Cunco instead wanted exclusive rights to the remotely operated scooptrams, which would give it an advantage in terms of offering better working conditions to attract the much sought-after, skilled scooptram operators. But it did not want to pay for all the development costs, and it would have preferred openness in the communication platform to avoid getting locked in to a relationship with just one supplier.

Ludvika relinquished its aspirations to recover all development costs from Cunco. The solution was so compelling that Ludvika's other sales companies quickly started selling it around the world. Mareeba in Australia was struggling to find skilled labor, so it was quick to adopt Ludvika's solution. Faced with this evidence, the competitive supplier Arvika felt forced to reconsider its assessment of the benefits of the solution and the size of the market. Arvika already had been working on the remote operation and automation of drilling rigs, such that it offered a solution that significantly increased productivity for such equipment. Therefore, Arvika adopted a view of remotely operated scooptrams as a natural extension of its existing offering, because adapting its own solutions to this type of machine would be straightforward. Yet Arvika has

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had to acknowledge that Ludvika now leads the LHD market, such that it must present a good reason for customers to prefer its solution over Ludvika's. The MD of Arvika in Chile hinted at a possible challenge to Ludvika's hegemony: an open communications platform that allows customers to integrate and operate multiple processes (i.e., different types of equipment) on the same platform. Ludvika's decision to use proprietary technology to protect its market share thus may have created a window of opportunity for its competitor.

5. Discussion

5.1. Dynamic effects and market shaping

The case illustrates two different situations related to the development of a customer solution to remotely operate a scooptram and achieve enhanced safety and productivity. The solution originally was created and implemented in Chile; when the opportunity arose in Australia though, Ludvika rapidly transferred its knowledge and sold the same solution to Mareeba, with little further customization. Thus the initial case of Cunco in Chile illustrates the process of co-development of a tailor-made, ICT-enabled customer solution; the case of Mareeba in Australia instead entails the sale of an existing solution that no other competitors could offer to a customer. Mareeba bought the solution from Ludvika because initially Arvika did not show any interest—in direct contrast with Arvika's stated approach to solutions, as expressed by its MD. Mareeba also considered Ludvika's equipment of superior quality compared with Arvika's, largely because it developed the solution first. Thus, an additional benefit of Ludvika's decision to develop a solution with its Chilean customer was that Mareeba in Australia regarded it as the first mover in the market and perceived that Ludvika's products offered higher quality. Before the solution was developed though, the market largely favored scooptrams by Arvika.

When the opportunity to develop the solution first emerged in Chile, Arvika opted not to participate, mainly because it regarded the potential market as too small. Once Ludvika engaged in creating a solution with the customer, Arvika lost the opportunity to participate, because the solution development demanded intense interactions, including reciprocal adaptation, mutual relationship investments, and risk taking, which is in line with extant research into the relational characteristics of solutions (Cova and Salle, 2008b; Tuli et al., 2007). For Mareeba in Australia, Ludvika also had an advantage: Its solution already was working in Chile. Arvika thus revised its initial position and expressed interest in developing a solution, because its further evaluation suggested the market was larger than initially believed. Thus the new scooptram-based solution shaped the market and created new offering spaces; the market-shaping effect resonates well with Storbacka's (2011) view on customer solutions. From a network perspective, these cases demonstrate the interdependence of companies, beyond the customer–supplier dyad (Cova and Salle, 2008a; Ford and McDowell, 1999; Kumar, 2005; Windahl and Lakemond, 2006).

Although the solution was co-created between Ludvika and Cunco, Ludvika retained ownership, to protect its market. By keeping its software code proprietary, Ludvika prevented other brands from using it. But this move also caused Cunco to feel trapped or locked in to the relationship (Sharma, Young, and Wilkinson, 2001), which can reduce customer satisfaction and loyalty (Normann, 2001). In this case, the customer expressed willingness to consider alternative suppliers, despite the immense benefits created with the current solution. Arvika's MD in Chile quickly grasped this opportunity and suggested entering the market by providing an easier-to-integrate solution, including open software codes to control the equipment remotely. Should Arvika (or another competitor) ultimately succeed in devising a solution based on nonproprietary software, Ludvika may lose the ability to exploit the benefits of its investment. Thus the creation of a customer solution introduced a new demand in the market—the need to integrate various processes—that requires the creation of a new solution.

5.2. Dynamic customer solution cycle

Among the drivers that we identify are the need to improve operational safety, which also can involve the need to improve product and service quality; the pursuit of improved efficiency or productivity of both human and machine resources; and the need for a better integration of multiple business processes. When the customer presents the initial problem, the complexity of the solution might be unknown (Nordin and Kowalkowski, 2010). The definition of the problem even could change over time. The solution co-developed by Ludvika and Cunco in Chile addressed the problem of remote operations for loading, hauling, and dumping ore. The primary motivation for automating the operations was the safety of the operator. However, changes in the business environment and the development of resources over the course of the parties' interactions changed the problem definition, such that increased productivity became a driver of further solution development (cf., Gadde, Hjelmgren, and Skarp, 2012). That is, the problem definition changed, and the potential solution differed too, as well as the potential market for the new solution. The increased productivity of the scooptram and the automation of some processes meant that the operator remained idle while the equipment performed routine processes. Here again, a new definition of the problem emerged (i.e., how to increase the productivity of the idle operator). The solution thus evolved to enable the operator to control more than one scooptram simultaneously, which entailed a new technological challenge, because the operator needed to control the machine not just remotely but also without seeing it directly.

Another change in the dynamics of interaction arose when the project took longer and cost more than expected. Ludvika's headquarters wanted to kill the project; on the buyer's side, things were not much better. Pressure kept mounting to cancel the project. Despite a high degree of interconnectedness, it would be hard to argue that a strong relationship emerged, in contrast with Amit and Zott's (2012) and Tuli et al.'s (2007) characterizations of customer solutions. The stress experienced by both parties was unlikely to enable trust to emerge; the potential lack of positive outcomes could not foster commitment. Eventually the project finished well, to the satisfaction of both parties, yet this outcome was not a forgone conclusion. The problems that prevent commitment cannot be ignored when planning for the creation of a new customer solution. To secure support, the parties had to revisit the conditions of their engagement, review their expectations, and reiterate the benefits that a successful solution could offer. In so doing, they also renegotiated the responsibilities of each party and scrutinized suppliers' abilities.

These findings suggest that regarding customer solution creation as a process that moves inexorably from problem definition to solution is too simplistic; its implementation is rarely linear. Changes in the problem definition return parties to the beginning; changes in the parties' interests and expectations affect the dynamics of the process too. The case we have presented thus challenges linear models of solution development, in that the parties continually returned to problem definition virtually every time they reached a solution milestone. The pace of progress thus was muddling, as the multiple parties sought to reconcile their ever-changing interests (cf., Lindblom, 1959). The eventual solution may be less efficient than desired, due to the loss of support, though our case also illustrates a novel, more efficient, and more effective solution than initially expected. On an aggregate level, this process resembles a gradual transition toward solutions, as has been described in other industries in which companies operate with an installed-base business logic (Kowalkowski, Kindström, Brashear Alejandro, Brege,

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and Biggemann, 2012; Storbacka, Windahl, Nenonen, and Salonen, 2013).

Other challenges to customer solutions are pricing and intellectual property rights disputes. Suppliers expect to retain ownership of the solution knowledge but also seek to charge the customer as much of the development costs as possible. Customers instead prefer to be the unique buyers of the solution, which can offer them an important source of competitive advantage. However, they are reluctant to pay all the development costs. Ultimately, customer solutions emerge when the supplier perceives a potential for further sales of a standardized, repeatable solution (Davies and Brady, 2000; Sawhney, 2006), such that it agrees to spread the development costs across all its customers. Suppliers still tend to retain the intellectual property rights to the solution, so they can extend it to new markets, even if customers enjoy a limited period of exclusivity to take advantage of the solution before competitors gain access to it.[3]

From suppliers' perspective, the cycle of customer solutions consists of two phases: (1) investment for innovation and (2) cost recovery and profits. The two phases each comprise three steps leading to the creation and implementation of customer solutions:

Phase 1 Investment for Innovation: idea generation → negotiation → implementation (adjustments) →
Phase 2 Cost Recovery and Profits: operation → standardization → new cycle.

Ideally, these steps progress linearly, but in reality, the transition from one step to the next often includes revisitations of previous steps. In our case, the development process returned nearly to the idea generation level when changes in the environment affected the customer's motivation to find a solution. The project's progress also moved backward, from operation to negotiation, when the project boundaries were redefined. However, expenditures never change direction: They keep growing as negative revenues until a suitable solution is developed and put into operation (see Fig. 1).

When the solution has been implemented (dotted vertical line), the period of cost recovery begins. This solution situation also influences the relationship with, and activities of, other actors in the network, such that the competitive environment changes and the phase division between before (investment for innovation) and after (cost recovery and profits) becomes illusory. Some suppliers may never recover their investments, because other actors appear on scene before the suppliers are able to take advantage of what Davies and Brady (2000) call 'economies of repetition' to deliver future solution at lower costs and more effectively. The solution attracts the interest of new parties, including some of those that initially declined to participate. Theoretically though, a before-and-after situation, as illustrated in Fig. 1, arises. In the before phase, costs and sacrifices are central, and keeping the parties committed is a major task, because the short-term costs overshadow the long-term benefits. For example, budgets might be exhausted, and senior executives prepare to kill the project; operations managers also may be reluctant to continue allowing production disruptions for tests of interim solutions. In the after phase, as soon as a suitable solution emerges and the benefits become more visible, competing with newly attracted suppliers becomes the primary focus. When Arvika realized the advantage that Ludvika had, due to its solution, it quickly sought to develop an alternative solution to challenge Ludvika's leadership. These results contest the argument posed by Krishnamurthy et al. (2003) that solutions reduce competitive intensity. In our case study, the solution instead attracted intense competition, at a higher level, at which the skills required for competition are more complex.

6. Theoretical implications

Our study offers three important implications for academic inquiries in solution domains. First, this research provides insights into the antecedents of customer solutions. Not all customer solutions are supplier driven, in contrast with the general view of customer solutions as value propositions developed and initiated by the supplier (e.g., Cooper and Budd, 2007; Cornet et al., 2000; Sawhney, 2006; Tuli et al., 2007). Instead, it aligns with the service-dominant logic, which acknowledges that many value propositions come from customers[4] (Ballantyne, Frow, Varey, and Payne, 2011), including customer solutions (Kowalkowski, 2011). Thus, solutions need problems that customers find important enough to undertake in-depth interactions and reciprocal adaptation with a supplier. However, even if a customer is willing to move toward solutions, it requires a counterpart that regards the problem as relevant enough to justify commitment and relation-specific investments, to seek out a solution. Even if the value proposition is initiated by a key customer and the supplier is keen to invest time and resources to co-develop a solution, the supplier's engagement is not guaranteed unless, in its evaluation, the size of the potential market for a standardized solution is large enough. These findings support Davies and Brady's (2000) call for repeatable solutions and Storbacka's (2011) view of demand creation for solutions. Once the solution has been standardized, new demand emerges, and the supplier's investment can be recovered—and profits obtained—by selling the solution to other customers. The creation of customer solutions thus begins with customer needs, but it progresses to the next stage only when the supplier finds sufficient motivation in the potential for future business. Because suppliers ultimately hope to standardize the solution and sell it to a broader customer base, one-off businesses problems likely are less attractive in terms of co-developing customer solutions.

Second, our analysis unveils the dynamic, emergent, nonlinear nature of co-created solutions, in which the interests of the parties change during the process. Customer solutions, similar to other innovation processes, proceed through multiple steps, from idea generation to final implementation. The drivers of the creation of customer solutions are not limited to the needs or problems of one party though; they result from a combination of forces that keep changing (Cantù, Corsaro, and Snehota, 2012). Customer solutions are more than integrated bundles of products and services, using equipment manufactured for a specific purpose. The ultimate solution may apply to a customer's problem that is significantly more complex than the basic function for which the equipment was originally created. In this case, the problem initially defined around the need to protect operators evolved and passed through equipment efficiency and ultimately to operator efficiency. The solution thus was significantly more complex than initially predicted, such that it completely redefined the work of equipment operators and raised the playing field to a new level, where the challenge consisted of creating platforms that can integrate the operations of dissimilar products. Although solutions potentially provide differentiation, compared with the separate sales of products, services, and basic product–service bundles, our research challenges the conventional wisdom that successful problem resolution through the implementation of customer solutions builds sustainable competitive advantages and increases customer loyalty. Even if the solution creates significant customer value, they worry if only one supplier is capable of satisfying their needs. Developing and implementing a customer solution successfully thus may attract new competition and push suppliers to innovate further, to maintain their competitive edge.

[3] Similar agreements are common in the automotive industry for example. Autoliv, a leading supplier of automotive safety systems, maintains such arrangements with its key customers (Brandes, Brege, & Brehmer, 2007).

[4] Nordin and Kowalkowski (2010) illustrate the lack of understanding of customer needs exhibited by supplier-driven, product-centric solutions: A senior executive from the telecom firm Ericsson noted, "You say that you have total solutions, but I am afraid that we don't have any total problems."

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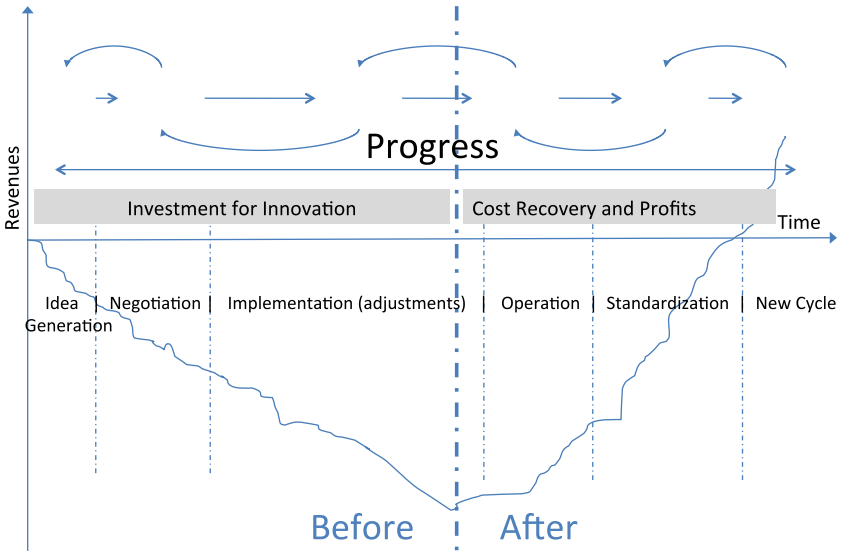

Fig. 1. Customer solution cycle.

Third, we reveal the effects of an extended network on parties' motivation to develop customer solutions and the consequences for customer loyalty. Parties' motivations to develop a customer solution change over time; the level of support that a project receives from executives also is likely to change. We posit that customer solutions are driven principally by forces in the business environment, created by the actions of those in the extended network. As in physics, when two or more vectors are added, their resultant force has direction and intensity. When the forces change, the direction of the resultant force also changes, redefining the problem and the scope of the customer solution. This description could explain why so few solutions arrive at their successful, predefined destinations. In addition, our findings support market-shaping and business networks theory (e.g., Corsaro et al., 2012; Håkansson and Ford, 2002; Storbacka and Nenonen, 2011) by detailing the interconnectedness of actors beyond the focal dyad. As a matter of fact, an exclusive focus on the customer–supplier relationship may hinder the wider-scale adoption of a solution by failing to understand other aspects of markets (cf., Diaz Ruiz, 2013). A solution affects the customer–supplier relationship, which also influences other relationships and determines how competitors (i.e., other customers and suppliers) and other actors react. The introduction of a customer solution, in particular a novel one, may spark changes in the activities of competitors that want to influence the market in their favor and enhance their own market position. What starts as a possible solution to a specific, predefined customer problem can evolve to take on much wider scope, creating a new market space and changing the competitive environment. However, these changes are not necessarily deliberate, and the network effects of the market introduction may be difficult to predict.

7. Limitations and further research

Our findings also are limited by our constructivist approach, the type of data gathered, and the influences of our own previous experiences. We aimed for methodological generalizability, as opposed to focusing on our population, so we cannot claim that our findings apply to the mining industry overall, because they do not represent any particular population. We invite further testing of our theoretical contributions with different approaches that can generalize the results to a particular context. In addition, research might attend to the roles of other actors, beyond customers and suppliers, which in our study remained somewhat invisible. We predict that in interactions with these actors, their interests and expectations influence the problem definition and scope of the solution too.

8. Managerial implications

Finally, our findings suggest that assessments of the viability of engaging with a customer to develop a customer solution, based on a limited appreciation of the potential market, might lead to incorrect decisions. The long-term implications of such decisions on market share and perception of leadership can be substantial. Initial budgets and schedules likely will require adjustments, because as the development of the solution progresses, the problem definition and the scope of the solution change too, as a consequence of changing customer needs and value perceptions. Therefore, some degree of flexibility is necessary, for both suppliers and customers. Suppliers should bear in mind that developing and even successfully implementing customer solutions does not guarantee customers' loyalty. Instead, customers seek a solution that might be standardized, to lower their portion of the development costs and avoid being locked in to a relationship with a single supplier. Therefore, suppliers must develop new and innovative skills to design "repeatable solutions" by migrating from tailor-made solutions. It requires designing standardized solutions elements and recycling experience from previous solution projects. Furthermore, managers should recognize that the implementation of a novel solution to a customer-specific problem has a market-shaping effect. The solution process in our research shows that competitors and other network actors most likely will respond to the market-shaping effect of the solution, something managers have to be aware of already when initiating the development efforts.

Developing solutions requires interactions and coordination of activities, not only between but also within organizations. Customers may benefit from a preliminary analysis of the internal implications of business solutions, as a solution affects the interests of several internal stakeholders who would be expected to collaborate. Likewise, the process dynamics of solutions imply that the parties' interests may change as new potential benefits of (and obstacles to) the solution emerge. As illustrated in the case, co-developed solutions may provide unique opportunities to achieve unforeseen

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benefits. Nevertheless, the clearer the definition of the problem and its motivation, the less muddling the solution requires, and the less expensive it should be. Ultimately, suppliers will seek to recover their costs one way or another. Regardless of the exact solution that gets co-created, the intellectual property generally belongs to the supplier. Therefore, customers should not expect exclusive access to co-created solutions and instead should focus on the benefits the solved problems offer to their organizations.

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Sergio Biggemann is Senior Lecturer in Marketing at the University of Otago School of Business, New Zealand. His research interest is on the dynamics of business relationships with special focus on the creation and implementation of business solutions, the time dimension on business networks and the role of fit supply chains and the performance of Multilatinas. His research has been published in journals such as *Industrial Marketing Management*, *Journal of Business Research*, and *Journal of Business and Industrial Management*.

Christian Kowalkowski is Assistant Professor of Marketing in CERS—the Centre for Relationship Marketing and Service Management—at Hanken School of Economics in Helsinki, Finland (www.hanken.fi). He also holds a part-time position as Associate Professor of Industrial Marketing at Linköping University in Sweden. His current research is concerned with service infusion in manufacturing firms, dynamics of value propositions, service innovation, and solutions marketing. He has published articles in such journals as *European Journal of Marketing*, *Industrial Marketing Management*, *Journal of Business Research*, *Journal of Business and Industrial Marketing*, *Journal of Service Management,* and *Service Industries Journal*.

Jane Maley received her Doctorate from Macquarie University, Graduate School of Management in 2005. She has held Managing Director roles for UK, US and Japanese Biotech multinational corporations, and works as an international management consultant and university lecturer. Her research interests include cross cultural performance management. Her publications have appeared in international journals including: *Journal of Business Research*, *International Journal of Human Resources Management*, *Personal Review,* and *Asia Pacific Journal of Human Resource Management*. She currently holds several board positions at educational and biotech organizations and is regular speaker at international business conferences and events.

Staffan Brege is Professor of Industrial Marketing and Head of the Division of Industrial Management at Linköping University. His research interests include outsourcing and supplier strategies, information technology, functional sales, and business development. Industry segments of special interest are the automotive, aerospace, telecom, and wood-manufacturing sectors. He has published articles in such journals as *Columbia Journal of World Business*, *Journal of Business Research*, *Scandinavian Journal of Forest Research*, and *European Journal of Purchasing & Supply Management*. He also works as a consultant and as a member in company boards of directors.

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