

Optimizing the services and lifetime of complex capital equipment

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Abstract

Every member of an industrial network marked by complex product and service delivery has their own “co-development history” associated with an innovation. A balanced individual “relationship scorecard” reflects the need for relationship and success justice among industrial partners. Non-chargeable innovation services simplify the “calculation” of such a justice by leaving out monetary buying costs. Strategic research and development initiatives where the cost is covered by other than the directly cooperating departments help mitigate the potential failure of innovation and foster readiness for co-creation. “Success” in terms of the supplier's development and the customer's perception may be considerably different.

Keywords: ServiceCo-development, Project Scoping, Economizing and Socializing Exchanges

Introduction

This paper examines actors' views on co-creation in an innovative, long term optimization initiative for complex capital equipment. We seek to understand the motivational, network related, and potentially diverging effects and possible synergies in technological evaluation. The study poses the following questions: 1. How can information from the operational field be obtained continually and reliably to a high quality and responsiveness? 2. How can co-development in a network comprising of a corporate research centre, an internal service organisation as first order customer, and an external manufacturer's operation be established and maintained? 3. How can different levels of understanding, motivation, and goals be translated between the different actors' disciplines? 4. What can managers of operational improvement programmes learn about effective field-driven innovation across the interface between industrial marketing and manufacturing?

The research was carried out in a “Full Service” setting in the mechanical and electronic engineering industry. All aspects of maintaining, operating and repairing complex capital equipment of high technology plants are covered by a singular contract with the “Full Service Provider” that drew upon a state-of-the-art corporate research centre. The increasing complexity of machinery and the advantages of outsourcing to specialists had promoted this distribution of responsibilities between plants and service providing companies. The area of the engineering industry features high value, complex

and durable capital equipment, with little heritage in co-development approaches. We were able to arrange good access, having already established technical and organisational familiarity with the company and some of its customers. This access included with the team and project leaders, international actors and internal documentation.

Literature Review

The question of service innovation has become increasingly prominent in many industries operating with significant capital equipment, especially in the context of longer term full service contracts. The question is not so much one of enhancing or expanding the domain of service. Rather, it is the proposition that a full service contract combined with suitable key performance indicators, rewards, penalties and additional resources as in key account management, can allow buyers and sellers to exchange, facilitate, support, pilot and learn while offering often incrementally innovative and better-aligned service. The exchanges are often between businesses with different scientific and technical knowledge. One can expect that both parties need to get to know one another's business, operationally and in detail, to offer well-adapted service. And full service contracts provide an institutional means by which what may be seen as a generalized offer of continuing incremental innovation can be exchanged.

Scoping out the problem

Von Hippel (1977) pointed out that end users were significant and impressive innovators in adapting machine tools to their specific production activities, which maintenance engineers could learn about by making repairs and service at the users' premises where feasible (Suchman, 1987). Following Araujo and Spring (2006), it is not so much the entity being exchanged (ie, an offer's qualities of service, or extending service) that is of interest, but the social and economic arrangements that parties put in place and facilitate an exchange, by regulating access to maintain social technical capacities. This is quite a challenge when the entity to be exchanged includes the rather nebulous offer of incremental innovation, to be delivered over some period of time. The details of such exchanges are, despite the difficulty in setting them up, and the attendant organizing activities needed to accompany them over their duration, fascinating in that they often involve significant dual exchanges.

These arrangements have been termed co-development and co-creation (Vargo and Lusch, 2008). If we examine the details of co-development, we uncover complex dual exchanges, encompassing both the commissioning and offers to deliver upon incremental innovation (among other closely related entities) and offers of compensation for delivering such an offer, but also recognition of how buyers, the end user, recognizes the contributions they make to incremental innovation, their share of the exchange. For instance, do they offer to make some of their operations into a field trial? Do they offer valuable performance data, which can be revealing and perhaps leave them vulnerable as insights into their operations? Do the advantages created in an exchange seep out as service offers to rivals at some later stage?

2.2 From dyadic exchange to networks being made

A focus on exchange leaves us considering the contents of that exchange, already made dyadic through some mechanism such as pre-qualification, tendering and contract award. The procedures may seem clinical, affected against a procurement centre's normal procedures, and a vendor's allocation of a key account manager and resources, both perhaps reinforced by regulations such as competition policy. But the short discussion above indicates that companies, as parties to an exchange, find it difficult to achieve such

a clean ‘closing-off’ when that exchange involves offers of and for incremental innovation, especially where incremental innovation requires a dual exchange contributing to a co-development or co-creation, supported by something like a full service contract of some years’ duration (Geiger and Finch, 2009). For example, the service provider could be working upon other OEM’s assets, and the end user could have adapted that equipment so as to address a further customer’s requirements, or in uncovering operational contingencies not foreseen by the OEM.

In other words, we are interested in a network or collation of entities that hold an often dyadic exchange in place, but without any expectation that companies involved in an exchange can abstract this exchange, its terms, conditions, expectations, delivery, performance and review, cleanly. But how to envisage a network? We can sketch a network in which different companies (as actors in that network) may be connected with one another selectively and with varying intensities. In which case, companies are seen to be embedded in a network by virtue of the combination of stronger and weaker ties (Burt, 1992; Granovetter, 1973, 1985; Uzzi, 1997). Or we can take an action perspective, and explore the consequences of networks always being in the making (Callon, 1998a). For instance, if we observe stability, it is important to ask how actors in that network have achieved the condition of stability historically (Latour, 2005). Actor network researchers (eg, Law and Hassard, 1989; Law, 2004; Latour, 2005; Callon, 2009; Mackenzie, 2009) argue that human and non-human entities are continually involved in forming coalitions in order to acquire a capacity to act, such as in our case in this paper to make an exchange pertaining the capacity for incremental innovation. The implication for this paper is that networks are in the making and that dyadic exchange is held in place by a coalition of others, human and non-human, and the abstraction of its performance is a considerable achievement (Araujo, et al., 2010a).

Framing exchanges

Exchanges need framing (Callon, 1998b; Araujo, et al., 2010b). Irrespective of the stance researchers have taken on networks, as structures, as embeddedness, or as action, networks have no natural bounds, so need cutting (Strathern, 1996). Indeed, things in themselves have no essential unity, with compositions, demarcations and identities being made and retained, often carefully. Kjellberg and Helgesson (2006) highlight in the context of markets and exchanges three kinds of practices, all of which contribute to framing, as normalizing, representing and exchanging. These are all kinds of abstraction and means to a particular focal abstraction (an exchange), in which those actors directly involved in making an exchange can draw upon tools, customs, analogies, the expertise of others as intermediaries, theories and concepts, sometimes made practical where written in to software or textbooks. Framing is a process about what counts and how it counts as referents, intermediaries and facilitators of an episode of action, such as an exchange. Goods and services in markets may be arranged in an array depending upon their qualities (Callon, et al., 2002; Callon and Muniesa, 2005; Geiger and Finch, 2010).

Christensen and Skærbæk (2007) develop Callon’s (1998b) argument in comparing the development of accountability procedures in public sector contexts. They concentrate in particular on the time consuming work undertaken by accountants and their allies in making frames of accountability, and of the actors’ deliberations as to what they were allowing to overflow those frames. Significantly, they also refer to the principle established among researchers and policy makers of ‘New Public Management’. This is a nice example of what Kjellberg and Helgesson (2006) see in the context of market studies as a representational practice, as one which combines in abstract terms academic research, teaching and policy, made mobile as title or ‘movement’ in administrative and

political reform. It allows knowledgeable actors in practice to know and articulate what this means, as to what actions in their context fit with the overarching idea of New Public Management, or what they can do in context to recruit the idea, abstraction and frame of New Public Management as part of their network for action.

In summary, these are complex exchanges, often dual exchanges, requiring commitment and co-development among parties to the exchange. The exchange implies (in our case) a dyadic relationship over a period of time, but one which is achieved as an abstraction from a myriad of what can be come supporting and mediating activities in that exchange's network. Crucial dimensions to take from this review are the view of the exchange in a network, and we suggest here that the approach of actor network is useful given the efforts required to make the exchange as an action. The work required in making an exchange highlights the importance of abstractions, such as representations, models, and practices, and frames for exchanges.

Methodology

The case study research was carried through a large multinational company with a strong technological tradition in the power and automation industries. One of their expanding global businesses with considerable annual turnover, called Full Service Division, is concerned with managing all aspects of complex capital equipment of industrial customers' plants, independent from the equipment's origin. Usually, full service outsourcing contracts are for five years, with its technical staff permanently on-site. Renewals require e-negotiation, an expiration fraught with uncertainty and requiring the continuing demonstration of innovation in enhancing the controllability and stability of a customer's operations.

The existence of corporate research centres, one located in Germany, with a focus on life cycle modelling and research, enabled an in-depth scientific evaluation of the perceived innovation gap which seemed overdue in the area of plant control. Some of the competitors were already offering "reliability techniques" packages using statistical modelling of past maintenance data for extrapolation into the future. Competitors claimed that their technique were capable of predicting outages and optimal preventive maintenance cycles as well as means for cost optimisation of a whole plant. Not utilising and further developing such a potentially useful innovation might have put some of the contract renewals of Full Service outsourcing at risk.

Full Service division, operating world-wide, signalled its interest in developing a strategic technology innovation project that matched customers' aspirations. For its technical and organisational cooperation, partners and customers would receive leading-edgeresearchwork sponsored by its strategic funds. Classified as a "Fuzzy Frontend" venture internally, which meant the potential success was recognised as highly speculative by nature, this work was carried through mainly one researchscientist who also acted as the project leader in several months' work, developing the concept and collecting data, programming and evaluating the use and accuracy of analysis.

We arranged exploratory interviews with key contributors, capturing their narratives of the events along the project trajectory. We obtained drawings from interviews, as maps of how they perceived the project stages, organized around our promptings for critical incidents, which could be used a common reference points across interviews. Participants of the projectwere contacted and sent semi-standardised written questionnaires. Where necessary, additional questions were posed to seek clarification, and drawings of trajectories and network views were obtained. With secondary materials like notes from telephone conferences or milestone documentation, a comprehensive view of the past events and constellations were obtained.

Case description

Project scoping

Acting as an internal customer to CRC, the Full Service Division stated the initial problem, probable direction of research, and potential informants for technical input from everyday operations and experience on-site. A joint workshop of key proponents of the research project, both from CRC and FS, served as a kick-off meeting, followed by some months of basic selection and problem formulation in CRC also leading to the choice of the final project leader and executor who had not yet been part of the dyadic system so far. Having taken over materials and project requirement documentations from his project-inaugurating predecessors, the project leader tried to make sense of the problematic and scope. After some period of work, one of the project inducing persons, a Belgian manager from FS and simultaneously part of the steering committee, recognised that these interpretations did not follow the route induced by the kick-off. As there was mostly second- and third hand communication, he decided to temporarily act as a “broker” and engage in a personal dialogue with the researcher. As the dialogue took place, the new logic of cooperation assumed a shape as follows:

By means of an intensive one-day workshop of the Belgian manager and the project leader/ researcher on the CRC site in Germany, the group ensured that the initial purpose of the evaluation was fully understood and translated into research and development concepts and activities by the executing person. A reference site in Australia was recommended by the Belgian “broker” and the most versatile engineers named. In this stage, they served as the “Full Service” division’s representatives giving best-practice input by documentation, telephone conferences, and email contact, to Germany.

Seeing that the project was now taking the right direction, the Belgian manager stepped back and resumed a more observing role as part of the steering committee. Exchange of three sets of data and discussion, negotiation of interpretation, and first conclusions drawn jointly followed. Finalisation was then done by the project leader/scientist on his own and communicated to all parties who had contributed.

Project framing

In the initial stage, managers of the Full Service Division covered some of the sales and marketing functions. In later project epochs, the owner in Corporate Research Centre assumed that role to ensure on-going technical input and to communicate results. Technical and managerial staff in Full Service throughout represented an “abstraction layer” translating, converting, exchanging, and harmonising the exchange of knowledge, service and goods between the supplier, CRC and the factories served. It is the temporal constellation “Research & Development – Sales & Marketing – Abstraction Layer” which serves as a “frame” of the respective epoch for the case study undertaken.

Interactions and co-developing value

The flow of information and factual commitment was dyadic. Even defining the nature of the problematic to be researched and potential key contributions and expectations were communicated from Full Service, further processed and documented with refinement and feasibility statements from the Corporate Research division. A joint personal meeting on a Full Service site in Sweden of all three functions ensured a common goal and a high level of commitment and highlighted the strategic purpose of the project. This stage was highly visible and symbolic.

Detailed harmonisation of the goals occurred only when the project received its final “owner”, in the person of the project leader and researcher who had not yet participated in

the process. A “project document” had been carried over, which proved less efficient as a working template:

“describing the whole project and there were goals described . [...] What wasn’t there yet was the requirements document in the sense of, I should create a process [...] and what is this process to do and what it isn’t. And this you have to derive from the project objectives and didn’t exist yet.”

Identifying this divergence of objectives, a Full Service manager located in Belgium, also member of the project’s steering committee, tried to act as a broker between Corporate Research and Full Service and assumed the part of the sales and marketing layer. Described as “the Champion” by the project leader/researcher, in his own perception, in the course of the project he took various roles, including “Observer, Challenger, Specialist”. Although his schedule was typically demanding, he committed himself to take one day to come to the German Corporate Research Centre and communicate with the scientist. “So, whenever (..) we have the chance to sit down together and align with them, make sure we aim for the same thing, that’s co-creating and that’s big fun. It’s good to do.” From the scientist’s point of view, the Belgian manager’s commitment offered the potential for a quick harmonisation of thinking:

“Well we had these requirements, and in principle we went through these, and then I told him [the Belgian manager] how I understand what is written there and then he said, ah yes, you might well understand it like this, but originally we meant it like that, and thus consequently worked through this over the day..”.

The Belgian manager’s ‘insider’ position and connections to various successfully operating Full Service sites ensured he was fully aware of the technical and organisational goals and had the formal power and personal ties to establish working relationships to the reference sites and test cases needed. In the project leader’s perception, there was a high strategic significance of the research assigned from the Steering Committee, of which the Belgian “Champion” was part:

Technical and operational input in that stage came from an engineering excellence group in Australia, in the project leader’s memory “four people, but I only had regular contact with three of them, the fourth, of which I received an answer once, but immediately then”. They were engineers by education and function, recommended by the Steering Committee as particularly expert in the plant management techniques to be optimized and further developed. One of them, a versatile developer and trainer acknowledged in Germany as “the expert” (as the CRC division manager put it), states: “I arguably have the best understanding of what we need technically on our sites. Consulting and Service (maintenance on its own equipment) work does require some different aspects, so my input was purely for FS.”

As this reference group, in the project leader’s perception, “shared common interests with the Steering Committee” and maintains a “predominantly global view”, its input, mediated by the goals communicated by the Belgian manager, served for conceptualising and integrating the technologies to be tested into a workable test suite. They were also interested in a potentially positive outcome of the research: “If we had a more automated tool to use our process in, it would speed up implementation and result in more standardization and knowledge sharing.” But equally he saw the need for clarification of the project’s feasibility:

“I did advise at the start that variation on equipment would make automation difficult. [...] My gut feel was the part of the [lifecycle modelling project] I was involved with would be too difficult to automate, but I was pleased they would evaluate it independently and a lot more technically.”

After converting the requirements communicated by the Belgian “champion” and the global vision of the Australian engineers into a prototype for reliability modelling, the project manager needed the help of another group in the “abstraction layer”, this time for hands-on evaluation on a real plant site. As the Scandinavians accounted for by far most of the Full Service revenues, a large-scale timber processing plant with a long-term successful maintenance relationship was chosen where suitable master data from past operations were readily available for testing. An engineer and Full Service coordinator of the plant served as central point of contact for the German project leader. In his view, much of the project had already been realised when Sweden stepped in: “I was quite of sceptical about it would work. [...]. However, I wanted to ensure that the pilot would succeed and we could get some kind of global generic ‘approach’ and tool.”

Committing to the delivery of usable data for the calculative simulation, the Swedish engineer made sure all efforts were made to guarantee the pilot execution from their site. However, he realised that all the pilot could do was refute the viability of reliability modelling: “To make something good with poor master data. I think we have all seen this before and quite frankly I had my doubts. The results didn’t hold any usability for [the plant] or it wasn’t anything that [the plant] already knew..”. If there had been a chance to make the pilot calculations work, the project would have been successful. The perception of a successful cooperation was shared by the project leader, who stated that “without the pilot team, it would have been worthless”.

Analysis

We derived as metaphor the term “abstraction layer” from computer science (Floridi and Sanders, 2004) as the amalgamation of complex givens into “gradients of abstraction” (ibid: 5), which are meaningful to the target system. In this case, the complex combination and processing of specialist knowledge and capabilities of the Corporate Research Centre together with mediating influence of sales and marketing functions were amalgamated and re-separated into the gradients “product, service, and goodwill”. In our framework these compose the “value offering” to the end customers, initially leaving open the exact division line between products and services, and defining goodwill as any active commitment not necessarily required.

The project of reliability modelling had been recognised as belonging to the “fuzzy frontend”, a high innovativeness being associated with an even higher uncertainty of a marketable outcome. The cooperation of the Australian reference group and the Swedish pilot team were generously voluntary; according to the project leader showing a non-compensated goodwill: “Well, what in life is voluntary? [...] I think it was gentle pressure, [...] it was additional effort for them”. Even in problematic situations, the co-developers from around the world tried to maintain a constructive atmosphere, as the scientist puts it: “They always had a positive attitude and also told me so. [...] sometimes there were situations when you had to pass on unpleasant news and of course then will they not gladly cheer over the telephone, but it was always very constructive”.

Exchanges and relationship balance

Financially and organisationally, the reliability modelling project would in the project leader’s opinion have been not viable for a single Full Service division or even for the global FS organisation:

“These costs are gigantic, compared with their budget [...] if they would have had to carry [the project] through on their own, someone would have spent a quarter of their work time on it maximally, the scope would have been cut considerably, and focussed more on the present. Well I mean this project also has a certain futurity

character, well that means the, I say chances to implement it in the near future are not necessarily 100 percent.”

A financial commitment of the reference or the pilot group or Full Service in general would have distorted the perception of the cost/potential ratio and hindered the whole venture: “Yes, the idea came from them [Full Service Division] but they would certainly not have launched this idea, if they wouldn’t expect to receive [financial] support there.” The Australian specialist shares this view: “I would be completely guessing. As one of the technical leaders in a company – if I was a customer I would not have paid anything [..]”, as well as the Swedish engineer overlooking the pilot: “if you read the answers above, you can read between the lines and create an assumption how much the customer would be willing to pay...”.

These statements, together with the Steering Committee’s strategic decision to fully fund the project by corporate research means, imply that an overall “relationship justice” in a co-creation situation has to be sustained for enabling an equitable dialogue. Whereas in a chargeable industrial project employing a provider, the “relationship equation” includes financial transfer and monetary value of the goods and services received, such a strategic project, though still complex in its different exchange layers, is more easily overlooked.

A “relationship scorecard” providing a synopsis of the accumulated co-development process should according to the above statements be balanced in order to encourage a harmonious and ready exchange. We draw such a scorecard for the exchange “Corporate Research Centre – Full Service Division”: It will be the subjective judgement of every actor contributing to the scenario deciding whether a “relationship justice” is maintained and hence the scorecard is balanced. For the Full Service Division’s relationship with the customer served, the equation of the “status quo ante” – before the innovation with reliability techniques – will be more complex by the monetary element:

The aim of the Full Service division is to renew sales cycle, ideally through the sales and marketing layer, by upgrading from scenario as shown in (1) to scenario (2) including the reliability technique R*. The scorecard of the past exchange is getting increasingly unbalanced towards the end of the five-year Full Service maintenance contract. The provider’s superior skills and knowledge have been widely transferred to some of the relevant customer staff, and the high cost for premium services become more visible. In the words of the project leader: “the better the [full service team’s] work carried out in the five years had been, the less arguments you basically have for working there in the future, quasi a certain dilemma”. So the renewal should seek an adjustment of that equation again,

“to identify possibilities how you basically could demonstrate the customer a value, a value improvement for the future, [..] and then passing the customer, let me say a piece of paper and being able to say, ok, if you go for a contract renewal, then we can make possible for you these economies and if you go away, you wouldn’t have these.”

This is why a renewal “ceteris paribus” would cause a further disparity gap and in the long term threaten the “relationship justice” ensuring every participant in the co-creation exchange an equally high level of “success”.

Definitions of “success”

As the project was about to be finalised, the project leader ruminated on possible perceptions of success and what those might mean for the relationship:

“This is, I think that was an interesting project, now we will have to see what we extract there as results, something crystallised there, but this isn’t certainly yet, I just

think, it will boil down to a partial success, well of which I think it won't be a disappointment, it won't be like all wishes you had come true either, but I have a good feeling there that we will bring this to a close without separating in anger".

Considering the internal reaction in particular, especially of his team and superiors in Corporate Research, he adds: "I hope for a positive feedback. [...] also important that I, that the people then realise, with him you can do a project and something sensible comes out". The Australian expert considers as the positive outcome of the project that his hunches were verified systematically: "Our maintenance review process still does need a lot of personal assessment of requirements. This does result in variations between countries and sites. [...] I did advise at the start that variations on [...] equipment would make automation difficult." For the Swedish site engineer who had committed a considerable amount of work to gather real-scenario data the project outcome invoked even more ambiguous feelings: "we did try to make something good with poor master data. I think we have all seen this before and quite frankly I had my doubts. The results didn't hold any usability for [the timber plant] or it wasn't anything that [they] already knew." Implicitly, this combination of answers shows that in terms of the Swedish Full Service organisation and the timber plant, the project had not been a "success".

From the viewpoint of the Belgian manager, who had been a member of the Steering Committee and who had acted as a "broker" intermediately, the innovation success bore many facets – positive and negative. On the one hand, there was nothing marketable to sell, which would have been the most desirable outcome for the Full Service organisation. On the other hand, the feasibility of a lifecycle modelling in his opinion had been evaluated to the full:

"I think it was a successful research, even though the results were more or less negative. But the fact that we now know what is possible and what is not at this stage and the fact that we were having an open mind, to look at it from different angles [...]. And that's the commitment we have; or I have, personally."

The greatest "success" to him is being able to refute competitors' claims about superior offerings: "The way of we were thinking is not new. There are tools that actually try to convince people that it can actually be done, that it can be done. What we did, was try to ensure that it can be done, even simplify it. Then we discovered: it cannot be done. It's an upgrade in knowledge."

Discussion and Conclusions

Managers of technology and services providers take an important role in planning and facilitating innovation. Our findings imply that visionary developments have to be planned and executed strategically and advocated by superiors to ensure all support needed. As innovative projects are commonly considered risky, a strategic financial set-up with means of corporate research and development are likely to foster motivation for the project members as well as commitment of divisions and external customers needed for input, dialogue, and feedback.

Effective bi-directional exchange of skills and capabilities, which we call co-development, requires a strategic stance of an innovation project as an effective temporary network of committed specialists facilitates the process and improves the innovation quality. International co-creation calls for a high visibility of the venture throughout the divisions needed for input and support. The joint co-development "history" of innovative supplier and various levels of customers being "balanced" in the long run, extraordinary commitment in difficult project situations can be drawn upon, even more facilitated by the eventual absence of monetary transfer additionally to co-creation commitment. "Success" as being a manifold notion may have to be revised or

even re-negotiated in the course of highly innovative projects with an uncertain outcome. Such effective negotiation helps maintaining a balanced subjective perception of the relationship justice for all participants and ensures support for future innovation.

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