

Collaborative New Product-Process Development on a Global Scale

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Abstract

More emphasis has been placed on developing *cost-oriented* as compared to *innovation-oriented* supply chains. International business conditions dictate this must change. Evolving toward an organization capable of implementing innovation-oriented chains and adopting a collaborative approach to new product-process development are two mutually-supportive transformations. While it was difficult, the participants in this case study found ways to make the necessary changes happen. It reveals more concerning the *why* and *how* aspects of collaborative NPPD in the context of a global chain by examining several important managerial issues. More knowledge is provided to facilitate narrowing the gap between theory and practice as well as future research.

Keywords: new product-process development; innovative supply chains, case study research

1 INTRODUCTION

Supply chains fall within two broad categories: *cost-oriented* and *innovation-oriented* [37]. The cost-oriented variety focuses on reducing cost items such as inventory as well as throughput time via operational efficiency, whereas innovation-oriented chains concentrate on developing proficiency in creating and delivering customized goods and services [28]. These two strategies are not mutually exclusive – a firm should adjust the relative importance it places on cost, speed, and flexibility according to its current competitive environment [5][19]. The distinction between *cost-* and *innovation-oriented* then is a matter of emphasis. In practice more attention has been placed on the cost reduction aspects of supply chain management (SCM). Growing competitiveness in the international marketplace places a premium on an ability to respond appropriately to changing customer requirements in a timely manner. Thus organizations need to concentrate more on generating innovation-oriented chains distinguished by flexibility and overall chain efficiency and a key building block is collaborative new product-process development (NPPD).

The additional attentiveness given to cost-reduction as opposed to innovation is understandable. The economic rational of coordinating a sequence of activities to minimize costs seems evident and is intuitively pleasing [13]. It is reasonable to ‘pick the low-hanging fruit’ first by taking obvious actions suggested by an initial simplistic conception of SCM to provide immediate monetary benefits. The potential of innovation-oriented chains can only be fully achieved by viewing them as supply networks that are far more complex in terms of the nature of information and knowledge sharing [27]. Innovation-oriented chains demand organizations capable of genuine value-creating collaboration internally and externally. They often necessitate substantial adjustments to organizational culture and processes [21][46] and new administrative skills in the areas of relationship management and network control [33]. In short, they stipulate more managerial effort than cost-oriented chains.

While SCM is progressing, it is still considered an emerging discipline due to limited theory development [17]. One area where a theoretical basis is lacking is in justifying and understanding the organizational arrangements required of innovation-oriented chains [14]. In other words, both the *why* and *how* of employing and managing these types of networks are deficient. This helps explain the relatively low level of implementation in practice despite the premise that collaborative innovation concurrently enhances flexibility, speed, and cost-reduction.

A related area where practice also lags theory is collaborative new product-process development (NPPD) [4][46]. Theory regarding NPPD has evolved from advocating concurrent design and process engineering to promoting an integrative team process incorporating members near the beginning from internal functional areas as well as relevant external parties such as suppliers, customers, and logistics providers [2][9][10][15][16][38][47]. The importance of utilizing a participative approach to NPPD has been advocated in the literature for more than twenty five years and has been verified empirically; yet research reveals many firms do not take advantage of one [48][50].

1.1 SCM ↔ NPPD Interface

Researchers agree on the importance of an alignment between SCM and NPPD; however some view effective SCM as critical to successful NPPD while others perceive effective NPPD as critical to successful SCM [3][41][18][36]. In reality they are complementary processes. A new product will be less than totally successful if it is not chain-friendly [1]. On the other hand, international supply chains are reliant on a continuous development of customer-friendly products to distribute efficiently around the globe [14]. Effective SCM, particularly in the case of innovation-oriented chains, and effective NPPD accordingly should be regarded as *cumulative capabilities*, that is, they exist simultaneously in a mutually reinforcing fashion [12]. Innovation-oriented supply chains and collaborative NPPD share a number of characteristics including an emphasis on customer responsiveness, internal alignment as an elemental starting point, and the coordination of technological developments accomplished through the collective efforts of cross-functional teams representing a mixture of chain members. That they build upon and sustain each other is apparent in the context of the ‘green orientation’ drive internationally. This movement depends on a combination of innovative organizational practices such as integrated NPPD and coordinated supply networks [22].

1.2 Research Objectives

Practice does not always follow theory in regards to innovation-oriented supply chains and collaborative NPPD, two interdependent capabilities. One reason is a gap in the literature concerning understanding multi-organizational coordination in the context of product development [23]. A theme required to move a field toward becoming an authentic *discipline* is the evolution of scholarship that engages with, and changes, practice [17]. Case studies make a meaningful contribution to practice by uncovering useful general principles managers can translate and apply to their own circumstances [20]. This paper utilizes a descriptive case study to enable theory extension. It reveals more concerning the *why* and *how* aspects of collaborative NPPD in the context of a global chain. The main participants are a mining/production company located in Africa, an engineering/logistics firm (Switzerland), component manufacturers (Switzerland and Germany), and an international shipping company.

Actual experiences are drawn upon to discuss several important managerial issues including managing coordination across global chains, identifying and selecting suppliers in international settings, and cultivating organizational cultures supportive of collaborative NPPD, which by proxy addresses issues relevant to implementing innovation-oriented supply chains. These issues will be addressed with the objective of providing information concerning opportunities/problems related to each, including unexpected benefits/difficulties that arose. The overriding goal is threefold: 1) provide impetus for increased adoption of collaborative NPPD and innovation-

oriented chains, 2) help narrow the gap between theory and practice, and 3) offer stimulation for additional research.

2 BACKGROUND

2.1 Methodology

Case studies permit a level of in-depth analysis not possible with other methodologies [44]. They can make a useful contribution to both management practice and theory building, particularly in a relatively new field of research such as SCM [43]. A descriptive approach is employed here to provide a thorough description of a multistage NPPD within its own context, an advantage of case analysis. This enables theory extension by answering “Why?” and “How?” questions concerning collaborative NPPD. An opportunistic research strategy is present as ongoing access to a single informant -- the project manager affiliated with the central Swiss firm -- is taken advantage of to learn more about a development process stretching across several entities. While this is the most appropriate person to offer insights regarding the entire chain, his statements could not be verified by other participants.

2.2 Case Scenario

The genesis for this study was a challenge faced by one of the world’s leading producers of commercial diamonds with a mine and processing facility located in Africa. This firm will be referred to as the CUSTOMER. The central component of the CUSTOMER’s processing facility is a multilevel tower. The unpolished stones after a rough sorting were being conveyed into the top section of the tower where they were burned to eliminate organic material. The floor at this level then opened allowing the diamonds to drop via gravity to the next level where the stones were chemically cleaned. The bottom at this level then opened and the diamonds fell to a third level where further processing took place until the diamonds were pure.

The problem with this system was that diamond -- the hardest material on earth -- is not likely to suffer from abrasion caused by other material but they were scratching each other as they fell between levels. The CUSTOMER needed a trolley system to transport the diamonds from one stage to the next that eliminated freefalling and the resulting damage. This reduction in defects would not only decrease cost and collective processing time, but also would ultimately enhance customer satisfaction through increases in individual fabrication speed, product customization possibilities, and quality. In addition, they desired renovation of the apparatus that transferred the pure diamonds from the bottom of the tower to the treasury room. Their initial search for a capable provider in Africa and Europe revealed that the type of system needed was not available as a standard product. Their first challenge was locating a provider with the capacity to design, produce, and deliver a high-quality customized product.

3 MANAGERIAL ISSUES

3.1 Selecting a Supplier in the International Arena

Companies pursue sourcing options outside of their home country for a mixture of legitimate reasons and valuable leads to suitable potential suppliers can arise from a variety of possibilities [34]. The CUSTOMER was primarily driven by a strong desire to recruit a provider possessing leading-edge product and process technology. Furthermore their initial investigation indicated there were very few viable options even if they considered international sources. It is important

for the buying firm to undertake a detailed assessment of potential suppliers' capabilities before selection, especially when the supplier is to be integrated into a NPPD endeavor [16]. Given the complexity and uniqueness of the product, key issues for the CUSTOMER were selecting a provider with a compatible culture, i.e., one with which they could work effectively, and also one willing to coordinate a multi-organizational NPPD.

A buyer's NPPD practices will impact the performance of a supplier selected to become a colleague [40]. This is an example of improving internal alignment before attempting collaboration with external parties – a firm's functional areas must be on the same page before it can possibly hope to capitalize on a supplier's competence. The CUSTOMER's managers avoided some common missteps in identifying and selecting suppliers to join a NPPD project [35]. First, they acknowledged the expertise to be brought into the process was worth the trouble and expense, which is an intellectual barrier for some companies. Second, unlike other firms, they recognized the importance of the development process to the success of the product and the need for their involvement in it. Third, they understood that due to the uniqueness and complexity of the product estimating its likely cost beforehand would be a difficult, but necessary task. As such, they negotiated a combination of *cost-based* and *fixed-price with redetermination* [34] agreements with the eventual provider. This provided all parties a flexible foundation for collaborative decision-making and control from the beginning.

The CUSTOMER's managers initiated finding a suitable provider by attending a trade show in Germany. There they had initial conversations with members of an organization that had been in business approximately fifty years and was experienced in consulting, planning, realizing, and maintaining in-house engineering/logistics systems; with particular expertise in self-manufactured haulage systems, storage systems, automation, information technology, shipping technology, and dedicated systems. Most importantly, the representatives of this firm presented a 'can do' attitude why acknowledging they would become involved in the development of a product with which no one anywhere, themselves included, had any previous experience.

This firm, the PROVIDER, was located in Switzerland. The aforementioned project manager who provided much of the information for this case via an in-depth initial interview (and the use of handwritten notes) and several follow-up interviews was affiliated with them. A week after the trade show the CUSTOMER's representatives visited the PROVIDER's facilities and made presentations concerning their basic conception. At this time no contract was in place and the PROVIDER accepted when the CUSTOMER invited them to visit Africa. It is important to note both of these visits had social as well as business aspects. Each host company arranged for joint excursions to local areas of interest, dinner parties, and other possibilities for spontaneous interaction. This enabled the delegations to appraise people-related issues as well as technical concerns. The PROVIDER had conducted an intensive risk analysis [32] incorporating the technical and financial aspects of the project in-between the visits. After they examined the actual destination and became conscious of a shared image for the product with the CUSTOMER, they felt confident they would be able to construct such a system while realizing a fair profit. At that point final negotiations regarding the contract were completed.

3.2 Managing NPPD across a Global Chain

Evolving toward innovation-oriented processes entails major organizational change and consequently additional effort from managers, as noted previously. Implementation thus requires strong motivation, which can result from a clearly identified major opportunity [46]. The PROVIDER was now presented with such an opportunity. Not only were they committed to

creating a complex product that did not exist up to that time, the type of process demanded to do so was one with which they had little prior experience. A “rugby” approach to NPPD is superior to the sequential “relay” scheme in most situations. The rugby approach emphasizes multidisciplinary teams, built-in instability with subtle control, overlapping phases, transferring multifunctional learning, and strategic agility [47]. Different categories of products dictate contrasting types of development schemes. The NPPD undertaking described here called for the rugby approach as the product was more *high-technology/innovative-unique* as compared to *standard/functional* [7][27]. As such, the approach taken needed to emphasize:

- Quality and innovation, with cost viewed as a given;
- Trust, including the sharing of updates and other information, process technology, and *contextual knowledge*, i.e., expertise applied in the context of a specific application;
- Temporary quasi-firm arrangements that facilitate adapter-user face-to-face communication, interactive learning, a shared image of the product, team problem solving, and mutual-adjustments.

3.3 Project Management

Trust is a critical element of collaborative NPPD [14]. It was crucial for the PROVIDER to build upon the trust shown by the CUSTOMER through their administration of the project. Key behaviors that foster trust include meeting day-to-day commitments, open information sharing, demonstrating the other party is a valued team member, and building personal relationships across functional and organizational borders mutually perceived as fair and beneficial [11]. A valuable early step by the PROVIDER was taking a project management approach to NPPD.

Every NPPD project requires structured activities (e.g., status reports, prototype testing) that facilitate control and the appropriate expenditure of resources, as well as unstructured activities (e.g., impromptu meetings, the co-location of engineers) that promote creativity and collaboration [46]. *Coordination by feedback* is a managerial structure that attempts to enable flexibility while simultaneously maintaining control over the outcome of a NPPD project, and it calls for a heavyweight project manager [23]. A project manager has a multitude of responsibilities all falling under the main theme of simultaneously managing the ‘big three’ well – time, cost, and performance [32]. Doing so necessitates paying attention to two areas in particular: intelligent utilization of subcontractors and avoiding ‘sub-optimization’, that is, any party pursuing a course of action -- often with the best of intentions -- detrimental to a successful outcome for the entire project.

The project involved the application of new product features that were not standardized and the CUSTOMER, as might be expected, insisted on very high security and safety criteria. The trolley system consisting of six trolleys needed to be radio controlled, which meant each required its own notification code with individual manipulation. The system needed constant access to the dead-on position of each trolley to ensure they were all at exactly at the right spot on the right time. The containers incorporated into the trolleys were to be bulletproof with burglarproof doors. Also, the loading and unloading platform operations were to be free of direct human involvement, which meant they were to be fully automatic and under continuous control of the system. After unloading, the diamonds were to be stored in a treasury complex consisting of sixty drawers, each with a monitoring device that captured the amount of diamond within. Drawer software was to automatically send this data to the CUSTOMER’s accounting department. Finally, the PROVIDER was responsible for the comprehensive monitoring system

of the main facility (tower, treasury, and connection canals), which necessitated software compatible with the CUSTOMER's software and hardware.

3.3.1 Project Composition: External Parties

The project manager (PM) recognized that the PROVIDER would need the assistance of subcontractors if the project were to meet its time, cost, and quality objectives. SUPPLIER I, located in Switzerland, developed the positioning system for the trolleys and accordingly was heavily involved early on in workshops with the CUSTOMER and the PROVIDER. It was critical that they communicate what they were able to produce and how it would impact cost. The three-way communication among these parties was especially significant because the radio transmitters at the heart of the positioning assembly were imported from Israel at the suggestion of the CUSTOMER, which introduced sensitive *end-use* concerns [8].

SUPPLIER II, located in Germany, designed and delivered to the PROVIDER stock removal components and associated software central to the storage room operations that followed final cleaning. They provided parts necessary to assemble the prototype in Switzerland as well as those eventually shipped to Africa. They were involved early in planning, visiting the PROVIDER several times to get a better feel for the overall engineering aspects of the design and exactly what was needed. It was essential they were able to produce and deliver required mechanical components, even though many of them did not currently exist. SUPPLIER II had more hands-on involvement as assembly of the prototype commenced.

SUPPLIER III, located in Switzerland, produced the containers for the trolleys. In order to guarantee the high security standards required, they were also involved early in the process, communicating with the PROVIDER but not directly with the CUSTOMER. These were the main suppliers who of course engaged suppliers of their own. The PM delegated responsibility for these lower-tiered suppliers to the main SUPPLIERS, trusting in their judgment and management expertise.

The CUSTOMER was heavily involved throughout the nine-month design and development phase of the project. At least once a month managers and engineers visited Switzerland for consultation concerning ongoing adjustments to the product. The final external member of the project from the PM's perspective was an international shipping company (ISC) selected by the CUSTOMER. The ISC became involved in the latter stages as the ultimate physical configuration of the completed system was unknown at the launch. The types and number of shipping containers and transportation vehicles needed simply was not able to be determined at the beginning. The ISC provided assistance in ensuring the product was shipped to Africa safely, on-time, and as inexpensively as possible because they were familiar with the specific international logistics requirements involved.

3.3.2 Project Composition: Internal Parties

As might be expected the PROVIDER's engineers played a major role in most aspects of the project and were in constant contact with their counterparts with the CUSTOMER and the SUPPLIERS. One of the areas of difficulty for the project arose due to cultural differences regarding engineering practices. For example, European engineers are trained to use the minimum amount of cable to avoid tangle, which meant that in the design and construction of control boxes the Exit was always up with the Entrance at the bottom. In Africa convention was just the opposite. Thus the European engineers needed to think in a manner that seemed counter-intuitive based on their previous work experiences. Such problems can be overcome by selecting

project team members who not only have high-level skills, but are also politically and culturally sensitive, and have the capacity to place personal bias secondary to successful project completion. One worker was suspended from the project because he could not deal with African engineering philosophy, believing it primitive.

What may not be anticipated was the PROVIDER's elevated inclusion of internal parties often not given meaningful participation in NPPD processes [50]. Manufacturing personnel can contribute significantly to product/process design via their expertise in determining technical and financial feasibility, building and assessing prototypes, and capitalizing on integrative efforts with suppliers and customers [35][36]. In this case they were involved in all of the above and in particular played a major part in working with the CUSTOMER to determine the cost of possible product adjustments relative to their benefits. They also assumed the critical task of writing the precise manuals used by the CUSTOMER to assemble the system in Africa after it had been physically prepared in sections in Europe.

Purchasing can have an advantageous impact on supply chain performance if given an opportunity to participate throughout the NPPD process [26][31]. The role of Purchasing is twofold. First, they act as facilitators. In this case they were deeply involved with all of the PROVIDER's departments and suppliers to collaboratively determine the appropriate part to buy taking into consideration European standards for electrical devices and so forth did not apply. Purchasing was able to autonomously execute routine procedure in acquiring standard components for the project. Procuring the more important, unique, or even nonexistent items was more complicated. Purchasing needed to work closely with Manufacturing and Engineering to determine at what level of completion to purchase a part given the 'make or buy' nature of many elements. It was also crucial they guaranteed replacement parts were either available in Africa, or at least could be delivered to the CUSTOMER in the future, which raised important *total cost of ownership* issues [8]. The second role of Purchasing is as regulators. All acquisitions and related communications were administered by the Purchasing department under the direction of the PM or team leaders designated by him. Thus strict policies were established beforehand to eliminate *backdoor* and *maverick* buying [34], which were distinct possibilities given the complex network of relationships imbedded in the project.

3.3.3 Project Configuration

Figure 1 depicts the general configuration of the project to facilitate innovation and organization simultaneously via strong communication linkages once the key players were in place. Overall coordination of the project was established with the PM and the Central Project Team. They had the responsibility for general administration of the interrelated time, cost, and performance aspects of the project. This was accomplished through the use of two structured activities considered mainstays of project management [32]. The first was the establishment of key events as milestones that served as the focus for ongoing control. This provided a schedule for feedback concerning the status of the project's main in-process deliverables and consequently stimulus for meeting day-to-day promises. Second was the steps taken to control change in the form of 'scope creep'. This project gave rise to common reasons for potential modifications -- customer adjustments, team members' insights, newly-discovered materials, and innovative application of technology, so numerous possibilities for sub-optimization were present. All proposed changes were reviewed the Central Project Team as to their impact on the total project and approved changes were officially documented and incorporated into contracts and master plans.

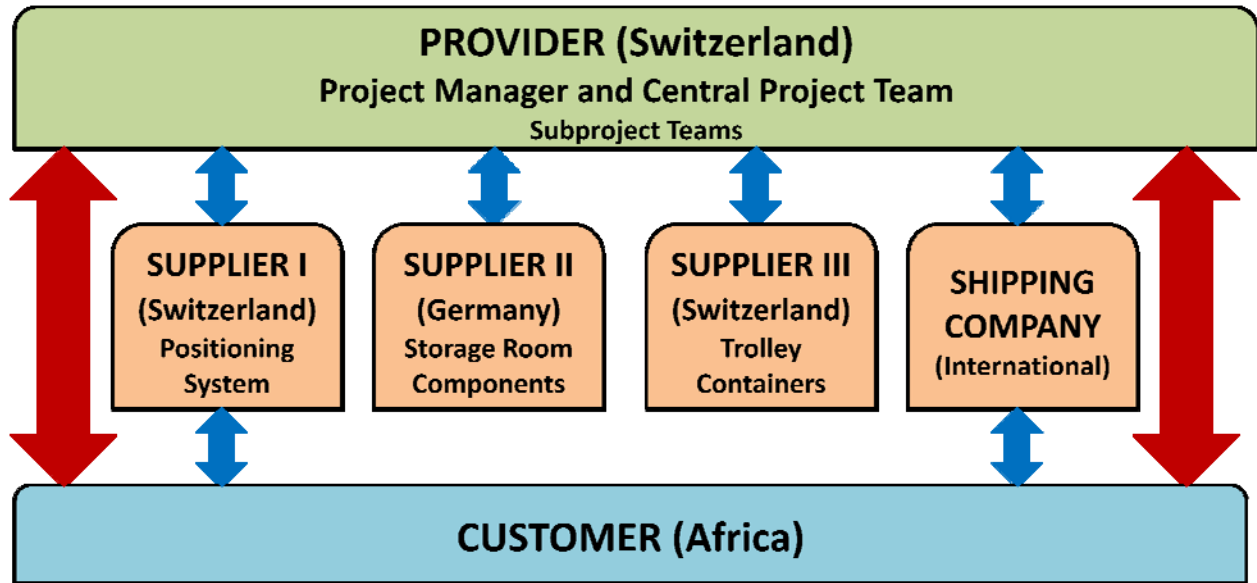


Figure 1 NPPD Project: Main Communication Links

Subproject Teams were created with broad responsibility for specific project attributes. These teams took on many of the elements of a rugby approach to NPPD, including quasi-firm arrangements enabling overlapping phases -- concept development, product-process design, prototype testing, and production -- that reduced total development time. The project configuration had a supple composition, with teams undergoing membership, responsibility, and contact adjustments as the project evolved to ensure an ongoing constructive exchange of know-how and information. At the same time, the PM along with the Central Project Team maintained a *Go/No-Go* control scheme [32]. As each critical step neared completion throughout the various aspects of the project, it was reviewed at least three times before official approval was given to begin the next.

3.4 Communication Flows

Many NPPD processes such as the one described here have numerous overlaps and feedback loops and require a complex adaptive mode of decision-making [30]. The integration strategy employed here falls into the ‘gray-box’ classification where the buyer and supplier jointly design components. Liaison positions, the mutual exchange of information, and accordingly, intensive communication flows are vital to achieving genuine innovation [25]. Technologies that support these flows include e-mail, video conferencing, and design systems such as computer-aided-design [46]. The PROVIDER effectively employed these types of tools whenever feasible throughout the project due to their lower costs. However as the NPPD progressed and especially as the PROVIDER began to construct the prototype, it became clear many of the consultations, mutual-adjustments, and so forth germane to the project were exceptionally complex and thus needed to be conducted in person.

4 IMPLICATIONS for PRACTICE and RESEARCH

Innovation-oriented processes -- including collaborative NPPD -- are more complex than cost-oriented approaches and involve additional effort from management, often in the form of modifying organizational culture and norms. The commitment required for any organizational change originates with motivation, which is frequently triggered by the appearance of a distinct challenge or opportunity of great consequence [22][46]. In a nutshell, innovation-oriented processes call for managers willing to challenge entrenched bureaucratic and cultural barriers to make their firms more competitive given the existing global marketplace.

Unfortunately many firms have not yet achieved the level of internal alignment necessary to begin implementing collaborative NPPD, much less the capability to venture into the realm of beneficial external associations [39][51]. A reason may be a lack of understanding as to the *why* and *how* of multi-firm coordination, particularly in the context of international chains. There is no predetermined stepped program that guarantees successful implementation of an innovation-oriented system. Each organization must develop its supply chain processes and networks based on its distinctive circumstances [6]. Furthermore the case scenario in this study – a one-of-a-kind application in the context of a relatively high-value final good – is certainly different from say, developing a carburetor for mass-production of a motorbike. Nonetheless a number of generally useful management principles and opportunities for additional research were uncovered.

4.1 The *Why* of Collaborative NPPD

The benefits of an integrated approach to NPPD have been promoted in the literature for over a quarter-century but practice continues to lag theory as noted previously. Research also extols the advantages of looking beyond the domestic arena in identifying and choosing colleagues to join these endeavors [42]. One central reason for becoming involved in collaborative NPPD on a global scale despite the extra effort required is *necessity*. The parties in the case discussed here recognize they could not have adequately met the challenge/opportunity that materialized if they had not been willing to employ a participative approach that included ‘foreign’ partners. The PM was convinced at the conclusion of the project that the considerable amount of additional input required was relatively small compared to the output realized.

A second reason for becoming involved in collaborative NPPD is that it is not only effective but *efficient*. That is, the best possible outcome may be achieved via a productive overall utilization of multiple resources. Managers frequently view the time and money used in working cooperatively as superfluous expense that reduces profit. In this case theory was proven true. The team approach across organizations enabled a broad-based sharing of contextual knowledge that facilitated high levels of innovation and quality while simultaneously reducing costs and development time. An example is the involvement of the SUPPLIERS discussed here. These relatively smaller firms were treated fairly and as valuable contributors to an important, unique, and multifaceted project. They reciprocated by way of numerous previously unimagined suggestions for improvement.

The third reason for becoming involved is it provides opportunities for the combination of *firm learning*, *evolving organizational culture*, and *future business*. The parties involved here developed high levels of trust and built strong relationships during the project. For instance, the CUSTOMER’s and PROVIDER’s personnel came to view each other as friends and found the conclusion of the project to be bittersweet. Given its successful outcome, it is likely that all of the parties will first seek out the others as future business opportunities arise. Additionally, this

was the initial occurrence of the PM's firm attempting a wholly integrated approach to NPPD after fifty-some years in business. He and the remainder of his firm feel the learning that occurred in the areas of company-wide teambuilding and knowledge exchange will be invaluable as they employ a collaborative philosophy into the future. They are certain this experience will give impetus to further progression toward an organizational culture that will provide hard-to-replicate competitive advantage.

4.2 The *How* of Collaborative NPPD

4.2.1 Generating Trust

Issues revolving around trust arose several times during this case. Collaboration requires profuse information sharing across inter- and intra-company boundaries. Attaining this level of information sharing first entails creating a climate of trust, not via effective technology alone, but principally through the efforts of people. Furthermore an atmosphere of trust internally is prerequisite to establishing trusting relationships with external parties [29]. This is another example of internal alignment as elemental to implementing innovation-oriented processes. The leadership of the principal participants in this case shared a level of trust within their companies that potential partners were able to detect, which helped facilitate their willingness to enter into the collaboration despite the uniqueness and uncertainty inherent in the situation.

Another focal point regarding trust is the axiom 'trust but verify'. Demonstrating trust does not mean acting purely on blind faith. An example is the PROVIDER conducting the intensive risk analysis prior to final contract negotiations. A *preventive contract* can facilitate a climate of trust because requirements and expectations are established jointly while simultaneously building in flexibility [34]. This was the case here, particularly in regards to the cost/pricing arrangements between the CUSTOMER and PROVIDER. Confidentiality can be a major concern in many NPPD arrangements, but it was not here given the uniqueness of the product. However, an issue that may be relevant to negotiating with multinational and/or multidivisional corporations did arise.

The CUSTOMER could have received a rebate by purchasing the parts developed by SUPPLIER I in Switzerland through that firm's African division. The headquarters for SUPPLIER I, located in yet another country, ruled that the Swiss division was entitled to the proceeds as their involvement had commenced at the start of the project. If the CUSTOMER had anticipated the possibility of this situation, they may have been able to reach a more advantageous arrangement during initial contract negotiations. Five key behaviors to cultivating a culture of trust have been suggested that provide a framework for more research [11]. More investigation in particular is needed in the context of NPPD, including the legal aspects.

4.2.2 NPPD as a Project

Every NPPD undertaking must be regarded as a project because each has (or should have) the following attributes: 1) a unique/one-of-a-kind set of circumstances, 2) a well-defined set of desired results called *deliverables*, 3) one clear dominant objective with cost, time, and performance elements, 4) a sequence of interdependent tasks, 5) a built-in degree of uncertainty, and 6) an internal and/or external customer providing funding [32]. Whether they were employed consciously or not, the utilization of project management principles was the foundation for successful accomplishment of the project described here. Some of those mentioned earlier include conscientious project selection, an appropriate person as a strong project manager, and

intelligent utilization of subcontractors and control mechanisms. Perhaps the most valuable principle employed was the formation of an overall project configuration that facilitated the project's main idea being the driving force behind all activity. The communication flows enabled a cross-country quasi-organization arrangement tight enough to ensure adherence to the project's mission while concurrently being sufficiently supple to encourage innovation.

One area already mentioned where improvement from the perspective of the PROVIDER could occur is in selecting of project team members with suitable temperaments in addition to satisfactory expertise. Another might be incorporating a group reward system – monetarily and otherwise – for project managers and team members based at least partially on the accomplishment of specific projects. Finally, it is unknown if the PROVIDER carried out a formal comprehensive post-audit at the conclusion of the project. These are invaluable to firm learning and improving the chances for future projects to meet their goals. Future research should examine more closely the connection between project management proficiency and the implementation of innovation-oriented processes, including collaborative NPPD.

4.2.3 Communication Methods

This case provides a good illustration of an effective mix of information technologies and personal contacts that would be beneficial to many NPPD endeavors. For the most part this enabled the timely sharing of hard data in combination with face-to-face communications that facilitated genuine collaborative behaviors such as team problem solving. However, team members at times experienced missing information or delays due to the size and complexity of this venture, which generated numerous multicultural interfaces. Administration of these interfaces could have been improved through the use of project management and/or product life-cycle management software [46][49]. Policy concerning interface management including the frequency and types of reports, as well as the coordinating software to be utilized, should be mutually determined during initial contract negotiations.

4.2.4 Participants

The PROVIDER in this case followed theory, but not common practice, by meaningfully including several of their internal parties early on. This provided a number of advantages as discussed previously. Their logisticians did not participate until late due to the nature of the project, also discussed. In most NPPD scenarios Logistics early inclusion can lead to multiple benefits [16][50]. Also, although Purchasing was seriously engaged from the beginning in some aspects, they were not involved in initial supplier selection, again mainly due to the nature of the project. This is an area where it has been demonstrated that Purchasing can usually make significant contributions [26][50]. Finally, it must be reiterated that firms must be painstakingly diligent in identifying and selecting external parties to become partners in developing innovation-oriented processes, including collaborative global NPPD. The relative importance placed on various supplier attributes will change based on the circumstances surrounding the decision. The example set here by the CUSTOMER is instructive in that they recognized the necessity of strategic and cultural alignment with the provider chosen and acted accordingly.

4.2.5 Conclusion

Research implies that evolving toward an organization capable of implementing innovation-oriented supply chains and adopting an integrative approach to NPPD are two mutually-supportive progressions [48][52]. Both require personnel at all levels to share information, learn

collaboratively across departmental boundaries, and think in terms of entire processes in becoming more flexible and innovative. Though difficult, companies performing well over the long-run are finding ways to make these transformations happen [24]. This is the state of affairs with the central participants in this case. While progress has been made in theory development in this context, for example [23][46][36], future research needs to ascertain more about how this can be accomplished using some of the leads provided here, perhaps in conjunction with colleagues from areas such as Organizational Behavior and Business Law.

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