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## The influence of learning in collaborative improvement

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**Abstract:** Collaborative improvement is a purposeful inter-company interactive process that focuses on continuous incremental innovation aimed at enhancing the partnership's overall performance. Considering that in such an environment the capability to learn jointly and individually is crucial, this paper takes a learning perspective on collaborative improvement and addresses the question: *How do organisational learning and collaboration interplay and affect improvement performance?* Based on an analysis of three dyads of the same Extended Manufacturing Enterprise, this paper concludes that a robust learning environment (willing and able to learn) creates operational, relational and learning outcomes – a self-reinforcing process. A weak learning environment (some willingness but limited ability to learn) creates operational outcomes but is sensitive to 'accidents' and thus at risk of actually producing negative relational and learning outcomes. A 'blocked learning' environment (no willingness to learn) may create good operational outcomes, but will not produce learning and relational outcomes. Consequently, it is doubtful if such situations are sustainable.

**Keywords:** Collaborative improvement; learning; performance improvement; action research.

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## 1 Introduction

Collaboration can help firms to lower costs and risks, to expand markets, to develop new products and to learn or to create new knowledge (Gomes-Casseres, 1997; Harrigan, 1988; Nohria and Garcia-Pont, 1991; Porter and Fuller, 1986). A growing body of literature even claims that opening the firm's borders in search for new knowledge is a prerequisite for coping with competition and complexity in the innovation process (Ahuja, 2000; Chesbrough, 2006; Laursen and Salter, 2006).

One of the challenges of achieving these benefits is building a collaborative capability that is flexible and dynamic, easy to understand and manage, valued by people and supportive of a broad-based learning culture. Another challenge is to overcome or soften the traditional understanding that the boundaries of companies are well defined, and instead view these boundaries as more fluid. Companies acting in a network have to understand that the success of every single company depends on the performance of all partners in the network. The actors in the network should construct a win-win situation (Child and Faulkner, 1998). The first step to accomplish this is that companies have to change their view on the supply chain concept. They should perceive their key suppliers as allied partners. Put simply, if companies want to create new capabilities and competitiveness by combining their knowledge and skills in a unique way, they must create improvement and learning links in order to enable personnel and information systems to work closely together (Badaracco, 1991).

Bessant and Francis (1999) analyse the potential benefits of interorganisational learning. These are:

- high potential for challenges and structured critical reflection from different perspectives
- different perspectives can introduce new/old concepts that are new to the learner
- shared experimentation can reduce risks and maximise opportunities for trying new things out
- shared experiences can be supportive to the individual
- shared learning helps explicate the system's principles and provides an environment for surfacing assumptions and exploring mental models outside the normal experience of the individual organisation.

Creating an interorganisational learning culture is not easy, and only limited research has been done in this area. In 2001, a major step in exploring this field was initiated, as a three year EU-funded project was established under the project name CO-IMPROVE (Collaborative Improvement Tool for the Extended Enterprises). This article takes its starting point in this research programme.

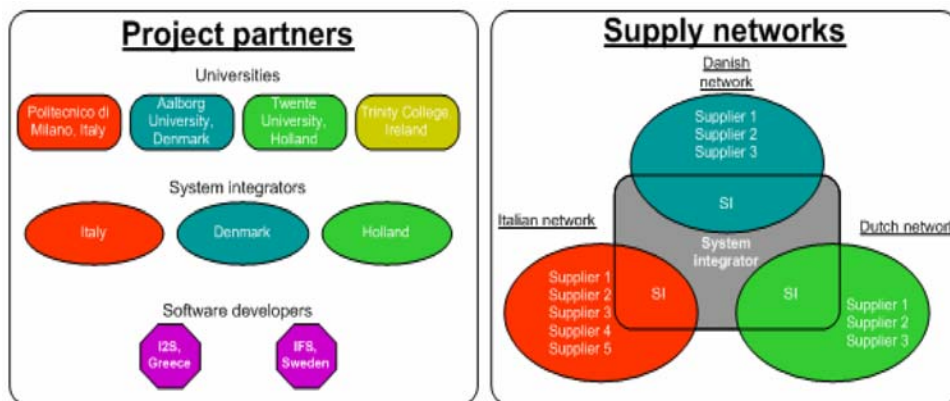
## 2 The CO-IMPROVE project

CO-IMPROVE was a three-year international research project aimed at developing and fostering Collaborative Improvement (CoI) – that is Continuous Improvement (CI) at the Extended Manufacturing Enterprise (EME) level – by exploiting the collaboration relationships between a customer and its suppliers within the network, in order to find always better practices and, consequently, enhance overall EME performance. Clearly, collaboration and performance improvements are hampered by the functional and geographical separation between the partners, which requires the EME to use non-traditional organisational, managerial and technological mechanisms to bridge these barriers and, thus, support CoIs. For this purpose, the CO-IMPROVE project aimed at developing the following innovative products:

- a business model of CoI, supported by
- a web-based software system, to enable and enhance the capturing, storage, retrieval, transfer and dissemination of knowledge generated as part of ongoing collaborative efforts to improve the new product development and order fulfilment performance of EMEs, as well as
- implementation guidelines supporting the situational design, implementation and ongoing development of collaborative, EME-level improvement, using the Business Model and Software System.

The partners and the overall structure of the empirical field are shown in Figure 1.

**Figure 1** CO-IMPROVE partners and the three supply networks



## 3 Research problem

As stated, companies must find new ways of becoming more competitive and one way to achieve that is to create a CoI environment. In such an environment the capability of partners to learn jointly and individually is crucial. However, to what extent and how the learning process will influence performance results in a collaborative setting is still unexplored. Therefore, the objective of this paper is to explore the question:

How do organisational learning and collaboration interplay and affect improvement performance?

## 4 Theoretical background

The purpose of this section is to present the theoretical background underlying this paper. The section is divided into three main theoretical areas: The first area concerns CoI, the second focuses on learning theories and the final section is about performance.

### 4.1 Collaborative improvement

In the EME CI of performance for competitive reasons not only involves the single company, but also stretches out to the collaborative operations of all the companies in the EME. As firms are forced to reexamine, at a strategic level, the way they do business in order to add value and reduce costs, it becomes clear that the individual firm is an insufficient entity for identifying improvements (Harland et al., 1999).

CI is ‘the planned, organised and systematic process of ongoing, incremental and company-wide change of existing practices aimed at improving company performance’ (Boer et al., 2000). This definition suggests that CI is an intra-firm activity and, indeed, most of the theory on the topic does focus on CI within the firm. However, the battlefield of competition is increasingly moving from the level of individual firms to that of supply chains and networks, including EMEs. Consequently, new approaches must be developed to enhance both the business performance of EMEs and the CI of their performance, relative to that of other EMEs. CoI combines the concepts of EME and CI into one. CoI is simultaneously concerned with bringing about improvement in the EME practices and performance, and with developing the EME’s improvement capabilities. Thus, it is an evolving systematic change process that is undertaken in a spirit of collaboration and learning. The CO-IMPROVE project team defined CoI as: *a purposeful intercompany interactive process that focuses on continuous incremental innovation aimed at enhancing the EME overall performance*. The differences between the CI and CoI are summarised in Table 1.

Although the concept of open innovation is still rather open itself and mainly concerns outcomes with a higher degree of newness, we may find some parallels to CoI, especially regarding relationships. In many ways, open innovation differs essentially from the ‘old’ closed innovation paradigm (Chesbrough, 2003). The concept includes such key issues as a corporate willingness and ability, perhaps deliberate strategic choice, to make use of a variety of external knowledge (e.g. suppliers, universities, customers and users (von Hippel, 2005) and to collaborate with partners that hold the competences needed. Furthermore, employees need to have an open attitude towards working with external colleagues and knowledge. Trust is a crucial factor because it can function as a mediator between members of a given collaboration, and has been shown to have a positive, albeit limited and indirect, impact on performance (Knudsen, 2007).

In a sense open innovation is seen as a collective process (Knudsen, 2007). The necessity and (claimed) advantage of doing this are due to changes in business conditions such as the intensity of and swift interdisciplinary fusion of technology and knowledge as well as the emergence of many new business models. These factors tend to spur pooling, sharing and learning amongst companies.

**Table 1** CI versus CoI

<i>Area</i>	<i>Key components of CI</i>	<i>Additional key components to CoI</i>
Strategy	<ul style="list-style-type: none"> <li>• Clear strategic framework for CI</li> <li>• Long-term goals and short-term targets</li> <li>• Communication of CI strategy to all employees</li> <li>• Top management commitment</li> <li>• Long-term company wide perspective</li> </ul>	<ul style="list-style-type: none"> <li>• Shared goals and vision with regard to CoI. Mutual understanding of CoI strategy of all the companies</li> <li>• Company/EME commitment towards CoI</li> <li>• Long-term optimisation instead of short-term orientation</li> </ul>
Culture	<ul style="list-style-type: none"> <li>• Shared belief in the value of small improvements</li> <li>• Belief that all employees have creative potential</li> <li>• Treating failure as a learning opportunity</li> </ul>	<ul style="list-style-type: none"> <li>• Shared belief in prosperity through collaboration and improvement</li> <li>• Trust</li> <li>• Openness in sharing information, learning moments and knowledge</li> </ul>
Infrastructure	<ul style="list-style-type: none"> <li>• Flattened hierarchy</li> <li>• Team working and flexibility</li> <li>• Devolution of decision making and empowerment</li> <li>• Effective communication channels</li> <li>• Commitment to training and personnel development</li> <li>• CI facilitators</li> <li>• CI ‘vehicles’ such as problem solving groups or CI teams</li> </ul>	<ul style="list-style-type: none"> <li>• Effective communication channels</li> <li>• CI ‘vehicles’ such as problem solving groups or CI teams</li> <li>• Devolution of decision making</li> <li>• Commitment to exploiting and exploring improvement potential inside collaborative relationships</li> </ul>
Process	<ul style="list-style-type: none"> <li>• Formal CI/problem solving cycle</li> <li>• Capture and transfer of learning</li> <li>• Recognition and reward of CI activity</li> </ul>	<ul style="list-style-type: none"> <li>• Capture and transfer of learning between and within companies</li> <li>• Benefit sharing</li> </ul>
Tools	<ul style="list-style-type: none"> <li>• Company ‘toolbox’ with a range of CI tools</li> <li>• ‘Toolbox manager’</li> </ul>	<ul style="list-style-type: none"> <li>• EME ‘toolbox’ with a range of CoI tools that are applied similarly within the EME companies</li> </ul>

Source: Middel et al. (2004).

#### 4.2 Organisational learning

Many theories on learning processes have been developed, and many different learning theory schools can be identified. Excellent literature reviews on organisational learning can be found in Hedberg (1981), Levitt and March (1988), Huber (1991) and Dodgson (1993).

We elaborate on two learning models, which focus on the *process* of learning. The first learning model developed by Inkpen (1995) focuses on learning related to behavioural and cognitive change. The second perspective is an interorganisational learning framework developed by Larsson et al. (1998), which presents the idea that there is a dynamic relationship between the individual companies' interorganisational learning strategies. Both learning models will be used as analytical frameworks in the empirical study.

Inkpen (1995) indicates that organisational learning involves both behavioural and cognitive changes by the actors involved:

“change in behaviour without a corresponding change in cognition or change in cognition without a corresponding change in behaviour, are transitional states since they create a tension between one's beliefs and one's actions. The tension, however, is a cognitive tension between the interpretation of one's behaviours and other beliefs”.

Based on this, the author develops a framework that shows that integrated learning only occurs when change in behaviour and cognition takes place, and if no change happens, no learning occurs. Figure 2 is our interpretation of the framework from Inkpen's text, as the corresponding illustration in Inkpen (1995) is probably flawed.

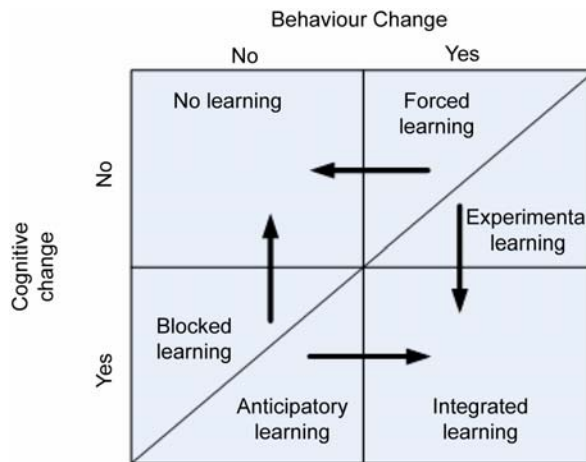
In this framework, four situations may occur: blocked learning, anticipatory learning, experimental learning and forced learning. Inkpen explains them as follows:

- *blocked learning*: happens when other beliefs override the situation and do not lead to a change in behaviour
- *anticipatory learning*: happens when a gap occurs between a change in cognition and the display of a change in behaviour. In a more difficult case, it can mean that the individual may not acquire the physical resources to translate the know-how into action
- *experimental learning*: performed by individuals who are willing to postpone their own beliefs in order to try a new behaviour and, in doing so, are open to new and different interpretations of the results of the behaviour
- *forced learning*: occurs when an individual is forced to act in a certain way in a given situation.

The second learning model we included in this paper is the learning framework developed by Larsson et al. (1998) (see Figure 3). The framework is built around five learning attitudes companies can take in relation to receptivity and transparency, namely *avoidance*, *accommodation*, *compromise*, *competition* and finally *collaboration*. Based on high receptivity, collaboration and competition are learning strategies that aim to absorb as much new knowledge as possible. They differ in their view on transparency: companies with a collaboration strategy are open (transparent) to (potential) partners; firms preferring competition are not. In contrast, neither the avoidance nor the

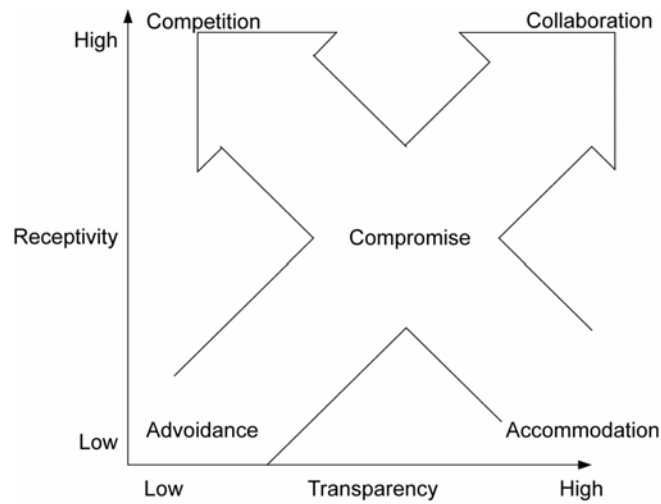
accommodation learning strategy assert any receptivity. Avoidance *de facto* means the company closes itself off from the world. An accommodation strategy means the company is open but passive recipient of new knowledge.

**Figure 2** The relationship between cognition and behaviour



Source: Modified from Inkpen (1995).

**Figure 3** Individual strategies for interorganisational learning



Source: Modified from Larsson et al. (1998).

### 4.3 EME performance

The central assumption of this paper is that learning plays a major role in CoI, but the question is: ‘How do organisational learning and collaboration interplay and affect improvement performance?’

In order to be able to address this question, we need a method to measure the causes and outcomes of CoI. This can be problematic because performance at EME level

is a complex concept to define and measure. Consolidated frameworks in Operations Management recognise three levels of performance (Slack et al., 2004):

- Internal operational performance, that is, those dimensions that describe the characteristics of the functional systems within the company, such as throughput efficiency, process capability, internal defects, inventory turnover and product development cycle time.
- External operational performance, that is, those dimensions that are directly perceivable and measurable by the customer and thus related to the competitive advantage of the company. They usually represent that part of corporate strategy which is concerned with functional strategies. Examples of external performance dimensions are the aspects of product differentiation such as delivery reliability, conformance quality or product innovativeness and results in terms of product price.
- Business performance, that is, the economic, financial and non-financial results that the company as a whole obtains in the market. Examples of business performance dimensions include profitability, cash flow, customer satisfaction and market share.

Transferring these concepts to the EME level is not easy. Especially, business performance is difficult to define and measure for the overall EME. An overall improvement in the network's operations does not necessarily lead to an increase of all partners' business performance. This depends on the balance of the power structure and the risk and benefit sharing mechanisms put in place.

However, established operational measures of time, quality, productivity and flexibility can be extended relatively easily from the single company to the EME. At the EME-internal level, the overall performance is generally the aggregation of the single performance of the partners. For example, the lead time for the EME is the time between the moment when the first input enters the network and the moment when the final product is delivered. Similarly, the conformance rate of the EME is the product of the conformance rates of all the partners involved. The EME external operational performance is often the performance of the final company, that is, the one that sells to the market. For example, the delivery reliability of the EME is the reliability offered by the final company. Clearly, this performance depends heavily on the results of all the EME's partners.

## **5 Methodology and empirical field**

The central methodology in the three-year CO-IMPROVE project was action research (by university teams working together with three EMEs) of action learning processes (by the EMEs).

Action research is a cyclical process of diagnosing, action planning, action taking, evaluating and specifying learning (Lau, 1999). Action research focuses on research in action, rather than research about action, in which members of the studied system actively participate in the process. In this way the researcher aims to contribute both to practical concerns of people in an immediate problematic situation and to the goal of science by generating emergent theory. The action researcher is not an independent observer, but becomes a participant, and the process of change becomes the subject



of research (Westbrook, 1995). Several broad characteristics define action research (Coughlan and Coghlan, 2002) as:

- research *in* action, rather than research *about* action
- participative
- concurrent with action
- a sequence of events and an approach to problem solving.

The development of people in organisations can be approached by the concept of action learning, which is used as the driving force of learning. It reverses the traditional learning process where the learning takes place before applying it. In action learning the starting point is action and it is based on two principles (Revans, 1998):

- ‘there can be no learning without action and no (sober and deliberate) action without learning’
- ‘those unable to change themselves cannot change what goes on around them’.

Action learning is formulated around Revans’ learning formula,  $L = P + Q$  (Revans, 1998), where,  $L$  stands for learning,  $P$  for programmed learning (i.e. current knowledge in use, already known, what is in books, etc.) and  $Q$  for questioning insight. Revans (1982) describes three processes central to action learning:

- process of inquiry into the issue under consideration – its history, manifestation, what has prevented it from being resolved, what has previously been attempted
- action learning is science in progress through rigorous exploration of the resolution of the issue through action and reflection
- action learning is characterised by a quality of group interaction, which enables individual and critical reflection and ultimately the learning process. This is the essence of action learning.

While the practice of action learning is demonstrated through many different approaches, two core elements are consistently evident:

- participants work on organisational problems that do not appear to have clear solutions
- participants meet on equal terms to report to one another and to discuss their problem and progresses (Marsick and O’Neil, 1999).

The implementation of action learning consists of four elements – the person, the group, the problem and the action relating to the problem in the organisation and learning from it (Pedler, 1997). Action learning is essentially built around a structure whereby participants meet in a group, discuss and reflect on the progress of the particular project(s) on which they are working. Next follow-ups are conducted in connection to the learning from that meeting in the day-to-day enactment of attempted solutions to the problem.

Marquardt’s (1999) six components of action learning provide a useful characterisation of the structure of action learning. These six components are given in Table 2 reflected to the CO-IMPROVE approach to action learning.

**Table 2** Action learning in CO-IMPROVE

<i>Action learning characteristics</i>	<i>Action learning in Co-Improve</i>
A problem – whereby complex organisational issues which touch on different parts of the organisation and which are not amenable to expert solutions are selected and worked on	The improvement of collaboration between system integrator and suppliers to enhance supply chain management through implementation of the software system and the business model
The group – are comprised of a typical number of six to eight members, who care about the problem, know something about it and have the power to implement solutions	Interorganisational network, comprising system integrator and their suppliers, with knowledge and power to implement the business model and software system
The questioning and reflective process	Network meetings at which new ideas were presented, actions reported on and new actions planned
The commitment to taking action	The networks were committed to implementing the business model and software system
The commitment to learning	The networks were committed to the action learning process
The facilitator	Members of the academic partners acted as learning coaches. This was a way to keep the networks focused on learning

The empirical field that provided the data underpinning the analysis presented in this paper consists of an EME, comprising a System Integrator and three suppliers (Milling, Turning and Casting). A System Integrator is a company that integrates components provided by suppliers. Some basic information of the EME is summarised in Table 3.

The three suppliers were represented in the CoI team by their top managers, two of them owners of the company. Three purchasers and their purchasing manager represented the System Integrator. Finally, two PhD students and two senior researchers from Aalborg University, Denmark, were involved as action researchers.

The interaction between the partners in the empirical phase of the CO-IMPROVE project was mainly through a series of EME workshops (monthly) and local project meetings (weekly). The researchers' involvement in and influence on the process were high. We facilitated many of the activities taking place in the implementation of CoI, and at the same time, we had many roles to fulfil (instigator, methodologist, facilitator, observer, reflector, inquisitor, project manager and change agent). Especially the two PhD students spent many hours in the companies: on average three to four days a week throughout the 20 months of action research and learning. The data collected was analysed through discussions with the CO-IMPROVE academic partners (research reflection team meetings every two weeks) and feedback to and from the industrial partners.

**Table 3** Summary of the competence/market and size of the companies involved in the EME

<i>System Integrator</i>		<i>Suppliers</i>		
		<i>Milling</i>	<i>Turning</i>	<i>Casting</i>
Competence	Mobile hydraulics	Metal parts	Metal parts	Foundry products
Employees	> 7500	90	75	250

## **6 Empirical findings**

In this section, the CoI implementation process in the Danish EME is presented through the perspective of learning. The unit of analysis is dyads within the EME. The two learning models presented in the theoretical section are used as important analytical frameworks.

### *6.1 The collaboration between the System Integrator and Milling*

Recently, Milling had gone through a generation change and the company was in a transition from a family driven company to a professionally-managed one. The new managing director was a dynamic and young but visionary person. He recognised that the company needed to become better in exploiting its knowledge and build a new management/production system – due to the recent growth of the company, the current management/production system was no longer efficient.

The interorganisational analysis showed that both Milling and the System Integrator had been engaged in technical and performance improvement activities but they had not performed any joint improvement projects. Generally, the relationship could be classified as transactional. However, the general manager of Milling had worked at the System Integrator for a number of years and from this experience, he knew the company very well and had developed a good personal relationship with the current plant manager of the System Integrator. Although the plant manager was not directly involved in any daily supplier activity, Milling had a high degree of trust in the System Integrator due to the general manager's intimate knowledge of that company, his good relationship with the plant manager and the purchaser, as well as many years of experience with the System Integrator in general. Most importantly, though, both companies and their gatekeepers (the System Integrator's purchaser and Milling's managing director) had a positive attitude towards engaging in CoI activities.

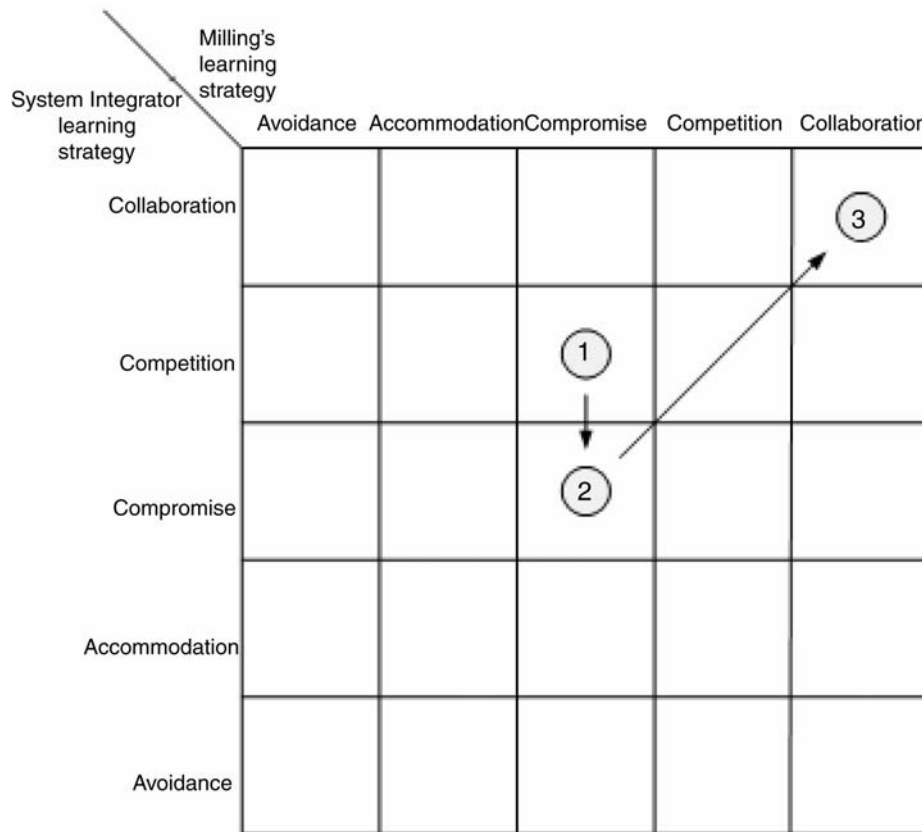
The framework of Larsson et al. (1998) can be used to illustrate the learning process that took place in this dyad in the course of the 20 months with respect to transparency and receptivity; (see Figure 4). In the beginning of CO-IMPROVE, Milling had a compromising strategy while the System Integrator had a competitive strategy, as about half of the System Integrator's production was in direct competition with Milling's production. The production department was afraid that Milling would 'steal' their knowledge and in the long run, thereby, also their work. Soon after the CO-IMPROVE project began, the learning strategy of the System Integrator changed towards a more compromising mode, for two reasons. Firstly, a change of strategic direction caused the System Integrator to further outsource parts of the machinery production. Secondly, a change in mindset among the production employees, who started to recognise that collaboration between them and the suppliers could be beneficial for both partners.

Very quickly, though, the relationship even moved to a collaboration mode. This was due to a couple of intertwined reasons. First, especially the new managing director of Milling was keen on collaboration. Secondly, a very positive climate developed between the responsible purchaser and director. In addition, the collaboration appeared to have a very positive effect on the learning strategy of the System Integrator as well.

The high level of transparency and receptivity in the strategy of both companies created a good foundation for CoI. Furthermore, we experienced a high level of

willingness, especially among the involved key actors who both changed their cognitive system and behaviour, which Inkpen (1995) characterises as *integrated learning*. This had a very positive affect on engaging and collaborating in CoI activities dyad.

**Figure 4** Development in learning strategies in the Milling



Source: Based on Larsson et al. (1998).

### 6.2 Improvement projects

The main objective of CO-IMPROVE was that the partners initiated and performed improvement projects together. In the dyad of the System Integrator and Milling seven improvement projects were initiated, which are given in Table 4.

The outcomes of the improvement projects varied. The direct (measurable) outcomes are summarised in Table 2. However, the improvement projects also had some indirect outcomes or spin-offs in the form of CoI competences in the areas of relationship management, inter and intra project management, conflict management, communication, learning and strategic and operational thinking. In the case of the SI-Milling dyad, the actors slowly built up these competences mainly due to their openness and willingness to change cognition as well as behaviour. In effect, also the collaboration between the two companies became more and more effective. The main problems that emerged in the dyad were, primarily, due to lack of resources.

**Table 4** Improvement projects initiated in the Milling dyad

<i>Improvement projects</i>	<i>Objectives</i>	<i>Achievements</i>
Implementation of TPM	Starting the implementation process of TPM at Milling, by transferring knowledge from the System Integrator	A good TPM implementation; 221 improvement projects identified
Quality	Reducing quality problems (starting point 25,614 DPM (defects-per-million))	Reached 1531 DPM after 12 months
Ship to line	Remove quality inspection when the System Integrator receives parts	The System Integrator achieved the target
Ordering	Electronic ordering process	Terminated because of lack of resources
Knowledge sharing regarding tooling	Sharing knowledge about tooling	Both organisations increased their tool-making knowledge
Outsourcing	Move two production cells from the SI to Milling	The removal was completed and the System Integrator saved cost
Kanban	Implement a Kanban solution in the supply of A and B products	80% A and B products on Kanban delivery

### 6.3 The collaboration between the System Integrator and Turning

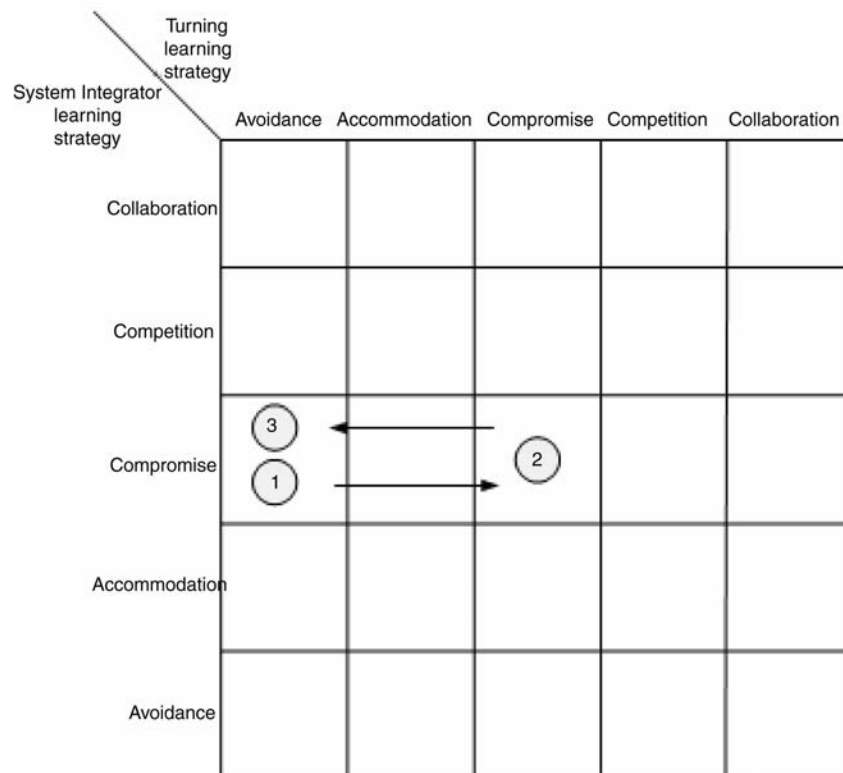
At the time CO-IMPROVE started, Turning's sales manager and a purchaser from the System Integrator handled most of the relationship between the two companies. With the System Integrator accounting for about 8% of its total turnover, Turning hardly depended on that customer. The two companies had previously engaged in technical and, to a limited extent, performance improvements, primarily proposed by the purchaser. As a dyad they had never engaged in any joint improvement projects, prior to CO-IMPROVE.

In the last five years prior to the start of CO-IMPROVE the two companies had developed into a relationship with considerable social interaction in terms of daily telephone calls, e-mails, faxes and some face-to-face interaction. The social interaction was very important. Turning's owner/managing director did not trust the System Integrator due to a history of high pressure from the System Integrator and removal of turnover. The sales manager (wife of owner), however, would like to start the collaboration with the System Integrator on a fresh note and saw the CO-IMPROVE project as a way to improve the collaboration. Her husband agreed to join the project, but did not expect the relationship to improve in the long term. The preanalysis also pointed that Turning was very conservative in adopting knowledge from their environment. They preferred to manage the company after their own principles with nobody telling them what to do.

Using the learning framework of Larsson et al. (1998), the course of the collaborative process between the System Integrator and Turning can be described as follows. Prior to the CO-IMPROVE project, Turning tended to apply an avoidance strategy due to what they felt were bad experiences with the System Integrator in the past. The System Integrator applied a compromising strategy. As the level of trust increased and the

benefits from the improvement projects were recognised, Turning became more compromising. However, a sudden replacement of System Integrator’s responsible purchaser led to a sudden collapse in the highly personal-dependent relationships the previous purchaser and key personnel from Turning had built up, and caused the relationship to ‘go back to square one’. The process is illustrated in Figure 5.

**Figure 5** Development in learning strategies in the Turning dyad



Source: Based on Larsson et al. (1998).

#### 6.4 Improvement projects

The interface between Turning and System Integrator was clearly defined. Turning did not want to open their organisation to the System Integrator. From the beginning, they were opposed to the System Integrator’s strategy of rolling out their TPM concept. Turning believed that they had an effective production system which they did not need to change. This behaviour highly affected the improvement work. In total four improvement projects were initiated but the achievements of the work were limited; (see Table 5).

The only project that had some success was the development of an excel-based purchasing agreement; unfortunately this project was not maintained. The poor outcomes can partly be explained by the lack of motivation and commitment towards the improvement projects. The company more/less left it to the researcher assigned to this dyad to accomplish the projects. Furthermore, they only slightly improved their CoI

competences because they were not ready to change, either cognitively or behaviourally. Consequently, the knowledge that was obtained from the improvement work and from the CO-IMPROVE project in general was not incorporated into their organisation. However, the company acknowledged that if the relationship should improve, they needed to work closer together following the CoI guidelines.

**Table 5** Improvement projects initiated in the Turning dyad

<i>Improvement projects</i>	<i>Objectives</i>	<i>Achievements</i>
Purchasing agreement	Implement electronic spreadsheet	Developed but not maintained
Quality	Reduce quality problems	No improvement
FMEA and VPC standard	Implement FMEA with VPC standard on all new products	The FMEA method was tested but not continually used
Delivery	Improve delivery performance	No improvement

### 6.5 The collaboration between the System Integrator and Casting

Casting was a conservative company and the organisation was highly hierarchically and functionally structured. The company could be symbolised as many small islands (kingdoms) with hardly any communication between the departments. Every department had responsibility for a specific process. A clear expert culture was present. This separation of departments was often problematic when problems occurred that had influence on the next process in another department.

Casting’s management found CI important for the survival of the company and they also supported a CI culture. However, in practice this attitude and the dissemination of CI was limited to the middle and top management levels. The shop floor employees did not feel the necessary support for working with CI. Moreover, the management attitude was that the shop floor employees should ‘only’ concentrate on their work task.

Before CO-IMPROVE, Casting and the System Integrator had a good relationship; the System Integrator regarded Casting as a strategic supplier. Particularly the purchaser, who had the responsibility for the relationship at the System Integrator (the person who had started the collaboration between the two companies), was fond of this supplier and over the years the relationship had developed into a ‘good-friends’ relationship, albeit with a focus on technical improvements. Performance improvement and cost reduction were not high on the agenda. The System Integrator’s purchasing manager was aware of this high level of social interaction but also saw a need as well as good possibilities for improving the performance of this supplier, and therefore, decided to assign a new purchaser to handle the relationship in the CO-IMPROVE project.

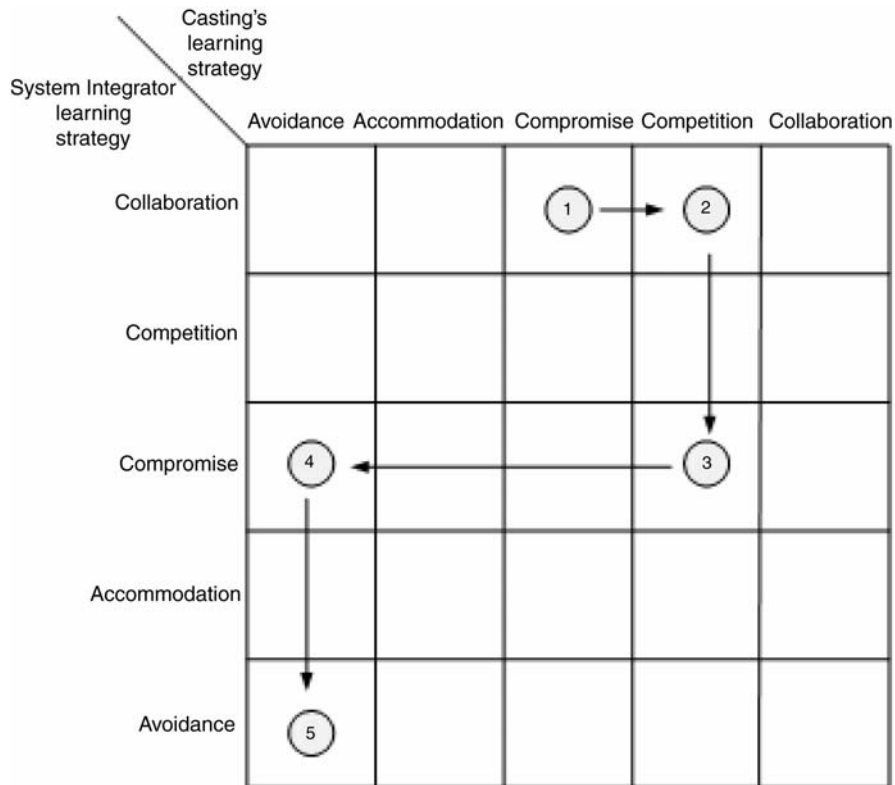
An analysis made again using the framework by Larsson et al. (1998) reveals some interesting results, which are depicted in Figure 6. From the beginning, the System Integrator had a rather collaborative oriented learning strategy. This strategy was first of all a product of the attitude of the responsible purchaser and, secondly, of the importance of Casting’s products to the System Integrator. In the beginning of CO-IMPROVE, a new purchaser was appointed to take care of this relationship. This purchaser also maintained a collaboration oriented approach, even though he was more transactional oriented than the previous purchaser. He believed that it could only be fruitful for both companies to improve the collaboration, both in terms of knowledge sharing and joint improvement. Casting did not share this learning strategy; they rather believed in a

compromising approach. They knew they had to share some knowledge with the System Integrator because of this customer’s purchasing power, but were quite reluctant to do so.

Shortly after the start of CO-IMPROVE project, the situation altered, triggered by the new purchaser and the ‘commercial reality’ in the market, which made the System Integrator consider moving some of Casting’s product to lower cost foundries. Consequently, Casting became more closed and did almost accuse the System Integrator of industrial espionage aimed at obtaining process knowledge which they could transfer to other foundries. Furthermore, Casting did not believe that the System Integrator was ‘telling the truth’; hence Casting began to see the System Integrator as potentially harmful to their business. This change in the relationship and strategy had a negative effect on the strategy of the System Integrator which, in effect, became compromising.

As the relationship became more and more strained, Casting’s learning strategy changed once again and became avoidant. As previously, the System Integrator followed after some time. The attitude of the purchaser, who became tired of the attitudes he met at Casting, was the decisive factor in the System Integrator changing strategy. The process was like a game of chess: Casting made a move; the System Integrator followed. In the end, both companies were in an avoidant mode but because of their mutual independences regarding products and turnover they stayed together.

**Figure 6** Development in learning strategies in the Casting dyad



Source: Based on Larsson et al. (1998).



In accordance with the learning theory of Inkpen (1995), Casting did change several times but mostly in terms of behaviour; their cognitive system hardly changed. Inkpen calls this ‘forced learning’. However, the behavioural change was more a part of a political game Casting played in order to satisfy the System Integrator’s demands for improvement. Towards the end of the CO-IMPROVE project, the System Integrator started to realise this.

6.6 Improvement projects

In spite of the problems in this dyad, the two companies managed to obtain fine improvement results. A major factor explaining this success was the new purchaser’s capabilities. He was a very structured person and a skilled project manager, and he used his power in a constructive way, in terms of creating improvement results. Furthermore, the actors improved their capabilities in the area of how to attract and solve joint improvement projects because of the positive project results. The purchaser also accepted the conflicts in the dyad, and he asked one of the researchers to become project manager/facilitator of the improvement process.

There was a clear advantage in letting the researcher take care of the management because he was a neutral person for both partners. The researcher also served as a communication channel for the partners – to some extent a mediator or ‘Justice of Peace’. In total, four improvement projects were identified and initiated; (see Table 6).

In terms of quality and delivery performance, the direct outcome of the improvement projects was successful. These two areas were improved considerably, even though the communication and collaboration were problematic. Furthermore, the implementation of TPM was a success. However, as the analysis indicates, these achievements caused a little more pain than pleasure.

**Table 6** Improvement projects initiated in the Casting dyad

<i>Improvement projects</i>	<i>Objectives</i>	<i>Achievements</i>
TPM	Implement TPM in one department of Casting	A good TPM implementation; 131 improvement projects were identified
Quality	Reducing quality problems (starting at 36,083 DPM)	Succeeded to reduced quality problems to 1263 DPM
Kanban	A and B parts to Milling must be delivered following Kanban principles	Succeeded
Delivery	Improve delivery performance (starting point 62% on time)	88% on time

7 Discussion

Outcomes in terms of operational performance improvement were quite different in the three dyads. The Casting and Milling dyads achieved fine performance improvements. An illustrative example is the joint quality project between the System Integrator and Casting where the DPM rate improved from 36,083 to 1263. This improvement clearly created a feeling of success in the dyad, which again positively affected the desire to continue.

At first sight, it seems that one of the main causes for positive performance outcomes can be ascribed to the learning strategy and attitude of the companies. In the Milling dyad, the partners were quite open and learned from each other's experiences. The whole TPM implementation process was building on the experience the System Integrator had gathered from seven years of implementation. Costs were reduced due to the System Integrator's willingness to share knowledge and Milling's readiness to learn. First of all, Milling did not have to re-invent the concept and they did not need to hire consultants. As the knowledge with the TPM concept within Milling increased, it was shared with the System Integrator. With the implementation followed an improvement of both companies' internal/external operational performance, and of their business performance. With the positive outcomes, the partners acknowledged that an open learning behaviour provides results. The actors in this dyad created a positive learning cycle, and the improvement results achieved further increased their motivation for learning. Although the innovation was mostly incremental in nature, the relationship resembles one of open innovation, supported by a good level of trust and open mindedness (Middle et al., 2004). The effort returned significant performance improvements, the benefits of which were shared between the partners.

However, when we turn our attention to the Turning dyad, we found that only very limited performance results were achieved. One of the reasons was that Turning was blocking learning in the beginning. As the collaboration evolved, they became more open but in the last phase of our field study, their learning attitude and strategy returned to the previous state, mainly due to their unfavourable perception of, firstly, the way the System Integrator handled its decision to appoint a new purchaser to replace the individual that had taken care of the dyad for many years and, secondly, the poor outcomes of a quality audit performed by the System Integrator (Revans, 1982).

Finally, they left much of the responsibility for the improvement work to the researcher involved in this dyad. Although this was convenient – maybe even necessary from a small business resource point of view – it was not particularly effective from an implementation or internal commitment perspective. At the same time, the actors in the dyad did not have the same professional problem solving skills as we found in the Casting dyad. Additionally, their commitment and motivation had been rather low throughout the process.

Based on just these two cases, it is easy to conclude that a positive learning attitude and a collaboration-oriented strategy are strong enablers for collaborative performance improvement. However, the Casting dyad did succeed in creating good performance results, although especially Casting more/less refused to learn. Towards the end of CO-IMPROVE, the learning attitude and strategy were still not aligned with the CoI philosophy. One may ask what actually created the positive development in performance improvement. We found that the main reasons for success were due to the System Integrator's continuing 'push' for improvements, a skilled project manager (purchaser), professional problem solving skills, actors who were very good in developing and implementing 'single loop learning' solutions and, finally, the neutrality and facilitating role of the researchers. However, the supplier's lack of receptivity to learning did have a negative effect on the relationship between the partners and created a negative learning cycle. This conclusion, however, is reached as we view the process from the perspective of implementing CoI. The relationship is far from that of open innovation and is best described as a transactional one with a high specificity of supplier

assets. As such, the relationship may have benefited from being formalised through, for example, a contract, which might have dampened the conflicts and especially the level of uncertainty on the supplier's side.

## **8 Conclusion**

The research presented and discussed in this paper departed from the assumption that an effective learning process enhances improvement of operational performance in terms of time, cost, quality, delivery, flexibility, etc. The findings presented in this paper suggest that this assumption needs to be refined.

In all the dyads, the same approach to CoI was adopted, but the learning strategies were playing quite different roles for the CoI processes and the outcomes in each dyad. Learning in the Milling dyad stimulated the improvement process which, consequently, produced operational results. This further enhanced the relationship and the learning taking place within and between each of the partners. In the Casting dyad, the same positive development did take place at the project level but this did not result in improved learning or a better relationship between the partners. Finally, in the Turning dyad, the outcome was scanty – initially, some operational results were obtained, but a number of incidents brought the relationship back to square one, obviously the learning had been limited in this dyad.

Based on this, we conclude that a robust learning environment (willingness and ability to learn as in the case of the Milling dyad) strongly affects the outcomes of CoI initiatives in terms of operational, learning and relationship outcomes. In such cases, true CoI takes place. In a weak environment (some willingness but limited ability to learn – as in the case of the Turning dyad), operational outcomes may be achieved, but if the learning and, especially, the relationship outcomes are poor, it takes only one or two 'accidents' for the relationship to deteriorate and the CoI activity to come to a halt. Such cases attempt to develop CoI but are always in danger of ending up in transactional improvement, if not worse. Finally, if the partners have a block for learning (no willingness to learn – as in the case of the Casting dyad), this does not automatically mean that performance improvement is affected negatively. In such cases, the actors need high competence such as project management and problem solving skills. Long-term success, however, will be more doubtful. Improvement initiatives in such cases are best described as transactional, rather than collaborative.

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