

# CHALLENGING EME'S TO LEARN THROUGH COLLABORATIVE IMPROVEMENT PROJECTS

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## ABSTRACT

Continuous Improvement is a consolidated concept in theory and practice, mainly in the context of a single organisation. Within the increasingly turbulent and uncertain environment the concept of Continuous Improvement should be transferred and extended to the level of collaborative continuous improvement to understand the improvement and learning process that takes place at the inter-company level, leading to the concept of Collaborative Improvement. This paper presents a number of practical results of a three years EU-research project on improving learning and continuous collaborative improvement that takes place in inter-organisational processes, e.g. the context of an Extended Manufacturing Enterprise. Within this project an action research approach is adopted through a cycle of workshops at the EME level to facilitate the collaborative improvement process and stimulate the learning process at the inter-organisational level.

**Keywords:** Collaborative improvement, inter-organisational learning, action research

## INTRODUCTION

Over the last decades, the external dynamics of firms have increased considerably. Not only have these dynamics created a situation in which companies have to respond quickly and accurately to changes within the market, they also constantly have to improve their performance. This creates new imperatives of competition between companies, increasingly moving from the level of the individual firm to that of a network of organisations.

Recently, a new stream of the literature on customer-supplier relationships observed that the study of the dyadic relation between one customer and one supplier does not allow to capture the overall advantages that could come from an integrated strategy of supply

management. This approach suggests instead to focus on the overall set of relationships that form the “supply network” of a focal company (Lamming, 1993). All these ideas are combined in enterprises, which extend each other in knowledge and capacities, leading to the concept of Extended Manufacturing Enterprises (Busby and Fan, 1993; Stock, 2000). In this Extended Manufacturing Enterprise (EME), continuous improvement 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 re-examine, 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), leading to the concept of collaborative improvement.

This paper presents a number of practical results of a three years EU-research project (Collaborative Improvement Tools for the Extended Manufacturing Enterprise, GIRD – CT2000 – 00299). The objective of this project is to develop a tool for the implementation and support of collaborative (inter-organisational) improvement and learning with the expectation of improving performance as a network of organisations as a whole. Within this project an action research approach is adopted where the researchers are both involved in managing and simultaneously studying collaborative improvement efforts (Coughlan and Coughlan, 2002). This paper will focus on:

- The design, execution and evaluation of specific collaborative improvement projects within a Danish, Dutch and Italian EME
- The approaches which have been adopted to facilitate and stimulate learning in the three EMEs.

The outcomes have already yielded results in operational areas such as quality, order management and cost reduction, but also provided both the researchers and the companies with important learning moments and experiences with regard to collaborative improvement activities.

## **COLLABORATIVE IMPROVEMENT**

Future survival and success of many companies will depend on the ability to manage and improve inter-organisational processes (Cagliano et al., 2002). Continuous Improvement, therefore, cannot be confined anymore at the intra-company level. Consequently, the concept of Continuous Improvement should be transferred and extended to the level of collaborative continuous improvement to understand the improvement and learning processes that take place at the inter-company level, leading to the concept of Collaborative Improvement. Collaborative Improvement (CoI) is defined as: “*a purposeful inter-company interactive process that focuses on continuous incremental innovation aimed at enhancing the EME overall performance*”.

It is simultaneously concerned with bringing about change in the EME, developing EME’s capabilities, and generating actionable knowledge. It is also an evolving systematic change process that is undertaken in a spirit of collaboration and learning.

## **METHODOLOGY**

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 cyclical 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 Coughlan, 2002):

- Research in action, rather than research about action;
- Participative;
- Concurrent with action;
- A sequence of events and an approach to problem solving

This approach is chosen because it allows the active participation of an independent observer. This allows the researchers to retrieve in-depth information on learning and improvement processes in an EME, and stimulates the development of a capability for learning and improvement in a network of organisations.

Within the different EMEs the Action Research approach is adopted through a cycle of workshops in which the following processes can be synthesized:

- Assessment and goal alignment;
- Improvement generation and selection;
- Improvement development and implementation;
- Results evaluation and sharing.

Within the EME the researchers have facilitated the identification and design of improvement projects on the dyads of supplier and system integrator in all three EMEs. The researchers then facilitated the process of carrying out the improvement projects and implementing the results. In addition the participants in the improvement projects were asked to reflect on the way the improvement project was carried out in order to stimulate learning processes.

Although the approach through the cycle of workshops is similar in the EMEs, the concrete content of the approach differs in terms of tasks, responsibilities, power and roles of the actors involved.

## **THE RESEARCH BASE**

This section presents the three cases: the Dutch EME, the Italian EME and the Danish EME. In this section a short introduction of the different networks is given, followed by a description of the action research process within the different EMEs

### *The Dutch EME case*

The Dutch EME is a network of a system integrator within the automotive industry and three of its suppliers. The System Integrator has selected the three suppliers, because the system integrator perceives them as highly involved in collaboration and dedicated partners. There are differences in the kind of relationship they have with the system integrator based on competence, dependence and the object of interaction. The companies within the Dutch EME are listed in Table 1.

*Table 1. Companies in Dutch EME.*

Company	#employees	Geography	Products
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System Integrator	425	The Netherlands (East)	Electro-hydraulic systems for operating soft tops and retractable hard tops on convertible cars as well as opening/closing car trunks
Supplier 1	200	The Netherlands (South)	Plastic precision parts and assembled products for the automotive, medical and pharmaceutical industry.
Supplier 2	55	The Netherlands (East)	Fine-mechanical parts for high-tech industry.
Supplier 3	160	Germany (West)	Cylinder-tubes for the automotive industry.

The Action Research process is organised through a series of monthly workshops, scheduled for a whole day, in which both academics and the companies participate. The initial idea was to start working with improvement projects in collaborative operations at the one-to-one company level. The collaborative improvement projects were identified through interviews with the representatives of the companies and the results of assessments with regard to the level of operational integration and collaborative improvement maturity. After the companies have selected a project, the plan was to start working on the collaborative improvement activity, whereby the researcher would act as a facilitator for all the companies and projects. A series of workshops was organised in which actually a learning cycle was planned:

- Choose a collaborative improvement project by and between the companies and work on it between the workshops;
- Present and discuss the improvement activities and results in plenum;
- Reflect on the process and progress of the project in order to learn;
- Diffuse the learning moments, experience and knowledge throughout the entire EME.

Within this approach the NL system integrator has deliberately chosen not to be directive or prescribe improvement projects, since it was felt that collaborative improvement is about shared goals and vision, mutual dependence and joint work and activities. After, some initial start-up problems the approach changed towards a more active role of the system integrator and up until now 5 improvement projects have been initiated of which to date two have been finished. The specific projects are listed in Table 2.

*Table 2. Improvement activities performed.*

<b>Relationship</b>	<b>Improvement activity</b>	<b>Results</b>
SI – Supplier 1	Redesign of a product, which causes severe problems during malfunction in system of the SI	New design and new material has been chosen, which should eliminate the problem
SI – Supplier 1	Proposal to produce an existing product of the SI of aluminium in plastic	Expected outcomes are 50% cost reduction for the SI and increase in Sale for the supplier
SI – Supplier 2	Information and communication on specifications of products	Increased information exchange and improved communication
SI – Supplier 2	Analyse and evaluate a change in tooling concept by the supplier	Increased insight in organisational structure and communication

		flows on both sides
SI – Supplier 3	Cleanliness of products (impact for the whole EME)	Expected results are better communication about the process of cleanliness of the products

During each workshop there is specific attention (separate part on the agenda of the workshop) for reflection on the process of collaborative improvement and collaboratively synthesising learning moments, experiences and observations that could be beneficially for further collaborative improvement projects. Also the diffusion of the knowledge generated as part of the improvement activities was addressed by a discussion and evaluation in plenum.

#### *The Italian EME case*

The Italian EME that is part of the CO-IMPROVE project consortium is a network formed by the aeronautical system integrator and a group of its suppliers. The system integrator has been chosen because of its recognised role of integrator of a wide range of sub systems into final or intermediate products, co-ordinating a complex network of suppliers that closely co-operate in order to achieve the required competitiveness. Four suppliers have been chosen to represent the different types of relationships that the SI maintains with its closer suppliers. In fact, they differ in size, location, type of activities performed and attitude towards collaboration. The companies are listed in Table 3.

*Table 3. Companies in the Italian EME.*

Company	#employees	Geography	Products
System Integrator	1800	Italy (North)	Jet trainer for the military market, aero-structures and nacelles for the civil market
Supplier 1	795	Austria	Composite parts for the aeronautical industry, both interiors and structural components.
Supplier 2	200	Italy (North-West)	Metal parts, which are generally machined and finished, sometimes also engineered, for the aeronautical industry.
Supplier 3	30	Italy (North—West)	Subcontracting of metalworking and surface treatments for the aeronautical industry.
Supplier 4	14	Italy (North)	Subcontracting of precision metal working for a number of industries.

The Action Research process has been organised through a series of monthly workshops that took place between May 2002 and February 2003 that involved the researchers and the people from the companies in the collaborative improvement process. The workshops were aimed at the one hand at observing the behaviour of the companies and the people from a research point of view. On the other hand, during the workshops the researchers have been giving directions and guidance to facilitate and support the collaborative improvement process. Although the process of action research is similar to the Dutch case, the content differs in terms of power, tasks and responsibilities.

The work performed during the collaborative improvement process can be synthesized in the following phases:

1. Assessment and goal alignment: in this phase each team, composed by people from both the supplier and the SI, assessed the level of Operational Integration (i.e. integration of operational activities between customer and supplier) and Collaborative Improvement of the customer-supplier relationship, in order to arrive at a shared picture of the level of collaboration between the companies. This assessment allowed in particular to identify gaps between current and desired integration on operational and relational dimensions, highlighting the most suitable areas for improvement.
2. Improvement generation and selection: starting from the common goals previously identified, each team generated ideas for possible improvement projects that required the collaboration of all the partners involved. Every idea needed to be analyzed and discussed in order to evaluate whether it was both feasible and respondent to goals and constraints. Finally, a single improvement activity at a time was selected, in terms of detailed goals, to focus attention and efforts in the short term.
3. Improvement development and implementation: once a specific activity had been identified, it was planned and executed, allocating resources in order to achieve the desired results. In particular, solutions for the problem considered were developed and implemented in the companies involved, in order to improve inter-company operations.
4. Results evaluation and sharing: in the last phase the team measured the improvement obtained in terms of both Operational Integration and Collaborative Improvement. These results, together with the experience during the collaborative improvement process, were shared at the EME level, allowing each team to learn from the others and eventually spread improvements across the EME.

After a first cycle, a new improvement cycle was started, starting the process from the second phase. In fact a new assessment in such a short time was not considered useful. The second cycle started directly with the generation of new improvement activities, while a new assessment will take place after a few cycles have been completed. The generation and selection of the new activities took advantage of the first cycle, both aiming at consolidating the results achieved and addressing new issues.

The specific activities performed by each relationship are synthesized in Table 4.

*Table 4. Improvement activities performed.*

Relationship	First activity	Results	Second activity
SI – Supplier 1	Eliminating cosmetic problems on fan cowls, and ultimately improving communication between the companies.	After implementing corrective action on four batches of production, 4 defects out of 5 were no more present.	Improve the Vendor Materials Review Request process and related corrective activities within this process.
SI – Supplier 2	Cost reduction for a part within a nacelle program	Cost reduction of 14% for the supplier that translated in a price reduction of 8% for the SI.	Development of an information system to monitor the status of tools on loan to the supplier.
SI – Supplier 3	Improve the order cycle management process, in order to educe delivery delays.	Delays on the specific part considered for the pilot initiative were reduced by 75%.	Monitoring the status of the employee certification required in the aeronautical industry.
SI –	Reducing the lead-time for the	The inter-company lead-time	Introducing a solution similar

Supplier 4	delivery of tools, specially for the development process of a new SI's prototype	was reduced by 5%, the internal lead-time by 57%; the overall lead-time improved by 54%.	to the one of the supplier in order to monitor the order cycle and avoid delays.
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During the process described above, the Action Research workshops were aimed at defining the process and tools to be used, at setting the activities and the plan, at presenting the work done by the companies between one meeting and the other, and finally, at working together on the improvement activities. In each phase the researchers and the people from the companies played different roles in order to facilitate and stimulate the collaborative improvement process. All the same, the process was supported by specific tools that were suggested for each step to guide the work (e.g. assessment checklists, Continuous Improvement tools, Project Management tools, and performance measurement tools). These tools were then used by the firms and finally their usability and usefulness was evaluated, leading to their refinement.

*The Danish EME case*

The Danish EME is a network between a system integrator within the mobile hydraulics industry, and three of its suppliers. The SI had the desire of choosing suppliers with three different technologies, an adequate size of turnover and subjective criteria such as the relationship to supplier, flexibility etc.

Supplier 1 was chosen because they are a very skilled foundry and employees at the SI like to work with this particularly supplier. Supplier 2 was chosen because the SI could see a potential of growth in the company and that the supplier can compete with the Chinese market in terms of price. Supplier 3 was chosen because they are very flexible and valuable for the SI, since not a lot of alternatives exist in Denmark, and the SI believe it is easier to work with Danish companies than foreign companies. The companies within the Danish EME are listed in Table 5.

*Table 5. Companies in the Danish EME.*

<b>Company</b>	<b># employees</b>	<b>Geography</b>	<b>Products</b>
System integrator	1800 (7000)	Denmark (Global)	Is among the largest manufacturers and suppliers of mobile hydraulics in the world today.
Supplier 1	220	Denmark	Is the second largest foundry in Denmark
Supplier 2	70	Denmark	Is a machine shop and work with all types of metal up to 65 mm in diameter
Supplier 3	85	Denmark	Is primarily a subcontractor with experience within CNC-machining of all types of steel, metals and foundry goods.

The Action Research approach is quite similar to the Dutch EME, but the researcher in the Danish EME have been much more involved in the on going improvement projects between the companies in between the workshops. The improvement projects that are started in the Danish EME are listed in Table 6. The improvement projects are not finished but ongoing.

Table 6. Improvement activities performed.

Relationship	Improvement activity	Results
SI – Supplier 1 & 3	Improve the quality from the supplier	Quality problems are less than 250 DPM on average.
SI – Supplier 1, 2 & 3	Improve the suppliers' delivery performance. Supplier 1: performance rate is 62%. Supplier 2: performance rate is 37%. Supplier 3: performance rate is 68%.	The goal of the project is to reach 97%
SI – Supplier 1 & 3	Roll out TPM from SI to supplier.	Rolled out TPM in the whole factory at the supplier
SI – Supplier 1 & 3	Implement a kanban system	Expected results are implemented kanban principles in regards to delivery and ordering
SI – Supplier 2	Develop a purchasing agreement, to make the trade between Supplier and SI easier and faster, and to reduce unnecessary contact.	A spreadsheet is up and running and has improved the re-ordering process.
SI – Supplier 2	Develop a FMEA and VPC standard.	Expected results are less quality problems and improve the start-up process regarding new products.
SI – Supplier 3	Improve the information flow regarding the ordering process.	Suspending of the project because the SI are in the process of implementing a new ERP-system

Before CO-IMPROVE the projects started between the companies were initiated because of an emerged situation that needed attention. The workshop within CO-IMPROVE has a positive effect on initiating projects and problem solving because the workshop has a setting that allows time to think about long-term problem solving and solving of problems with larger impact.

Throughout the empirical period (eleven months) the SI has moved from being dominating the meetings to become a more levelled participant. This is expressed when the groups work and the SI had the tendency of choosing improvement projects, where as now it is a mutual process. Other change in regards to the in the SI's behaviour were experienced. In the beginning the SI acted as "the teacher" where as they have changed into learning about its own organisation and about the suppliers.

Another tendency is that the learning has moved in the direction of an EME-level. The groups learn from each other's projects, copies them or parts of them, which is very beneficial for the learning pace. The EME also influences each other in terms of the level of project impact, but also in terms of deadlines and project speed.

## RESULTS

The Action Research process allowed to develop a better understanding of how companies can learn to collaborate and jointly improve both their operations and their relationships. The main findings can be synthesized as follows:



1. Within the different EMEs the action researchers plays in important role in facilitating and stimulating the companies to synthesise experiences, observations and learning moments. In the hectic of daily operations people easily forget to reflect and evaluate the process of collaborative improvement. Besides, people tended to approach problems in a very unstructured way, trying to rush to solutions, instead of analysing problems in details, jointly developing alternatives and evaluating solutions. The guidance provided by the researchers allowed people to learn, first of all, a method for approaching problems. In the future, companies should acquire more and more independence in leading the process, thus allowing the researchers to become pure observers.
2. The improvement activities performed took place at the level of customer-supplier relationships, but the progress and the results were constantly shared with the entire EME in the monthly workshops. This allowed to acquire an EME perspective and to share learning and ideas across the network. The beginning of the second improvement cycle showed how this approach was effective and allowed every relationship to build upon the results of the others. A collateral benefit of the process has been the better understanding, by all the companies involved, of the characteristics of the EME, developing a better awareness of the network dimension.
3. Within the different EMEs the used process of Action Research is similar through the cycle of workshops, but the content of the approach in terms of tasks, responsibilities and roles differ. However when we look at the results, which are achieved within the EMEs, we can state that there are great similarities in terms of learning moments, experiences, development of CoI relationships and focus of CoI on day-to-day operational activities.
4. A final aspect concerns the impact of Collaborative Improvement on the relationship between the companies: an important result is that companies know each other better after the CoI process and have developed a better interaction at the personal level, however a single improvement cycle is still a very little step on a long way, and much more can be expected from a prolonged initiative. The relevant fact, although collaborative improvement is ambitious at the outset, is that collaborative improvement is not additional to daily activities, but also includes (small) problems that were integral part of day-to-day operational activities in and between companies.

## **CONCLUSION**

The first implementation of Collaborative Improvement through Action Research was rather successful, since something that was never realized before was put in place in a real context, with very pragmatic people from the shop-floor working on real problems and achieving measurable results. The relevant point is that this was not a one-time experience, but a process and a method started to be learned by the people involved, as they are showing in the second cycle now under way. We can conclude that the success of the initiative has been moving from initiating improvement activities to solve specific problems to start considering improvement activities as opportunities to improve the relationship also if there are no problems.

Collaborative Improvement is not a natural process, especially for companies not used to Continuous Improvement; consequently it should be supported and guided adequately. A directive process is required in order to make the first improvement cycle happen, since it is something completely new for the companies involved. The adopted Action Research approach challenges and supports the inter-organisational improvement process and moves the EME through a cyclical process in which the approach stimulates the development of a capability for learning and improvement.

Many issues however still need to be addressed, and many questions to be answered. It is critical to study the evolution of the process from research-driven to spontaneous understanding which changes are needed and how it can happen. Besides, roles and tools should be further defined, to provide a more robust method for companies who would like to implement Collaborative Improvement.

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