

# AN INNOVATIVE COLLABORATION BETWEEN INDUSTRY, UNIVERSITY AND NONPROFIT AGENCY, FOR A COMPETITIVE INDUSTRY: A SWEDISH CASE

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## Abstract

In a knowledge based economy, manufacturing industry has to continuously improve their operations, processes and develop their employees in order to remain competitive in the market.

In this context, the collaboration between industry and universities becomes of vital importance. Universities and industry have traditionally maintained fairly informal or loose ways of cooperation when it comes to education. This article presents a fruitful cooperation which has been established between the University of Skövde, the Industrial Development Center in the region, IDC West Sweden AB, and the manufacturing industry.

The paper describes the development, lessons learned and the outcome of more than 3 years' experience of close collaboration between the different stakeholders. It presents a methodology, used by the consortium to help manufacturing industries to improve their competitiveness using a well defined process including: a company analysis, applied education and long-term coaching. A special focus is put on a long-term commitment by all partners. This alliance has performed more than 140 company analysis, conducted applied education for more than 2500 employees from more than 120 companies and performed coaching of more than 80 companies on site. The trend is that these figures will increase over time.

The established collaboration has been strengthened over this period of time by a number of shared research projects. One of these projects involves an evaluation of the impact that this presented consortium has had on the region's industry. Lean Learning Academies is another project that has been funded by the European Union within the Lifelong Learning Program, with the aim to increase the competitiveness of European companies and enhance the employability of students.

Keywords: University-industry collaboration, cooperation benefits, lifelong learning, education in production development and process improvement, Lean Learning Academy

## 1 INTRODUCTION

The University of Skövde, the Industrial Development Center in the region, IDC West Sweden AB, and the manufacturing industry of the region of Skaraborg have worked together over the past years following a standardized methodology of collaboration with the main objective of increasing the competitiveness of the industry.

This paper describes this successful collaboration between the three stakeholders in the region of Skaraborg in Sweden, and the results and lessons learned from this collaboration.

## 2 BACKGROUND

Sweden as other industrialized nations is highly dependent on an efficient and competitive production industry in order to maintain its welfare and economic growth. The manufacturing industry accounts for about 50 % of the Swedish export and employs around 350,000 people. If we include consulting and service companies that work directly with manufacturing companies, the number of employees reaches a total of 700,000. To appreciate the historical and current importance of manufacturing industry, just have in mind that an exceptional amount of global manufacturing companies, in relation

to its population, have their roots in Sweden. And up to this days their main operations, including production, is still within Sweden [1].

The global competition in the manufacturing industry is increasing. Many nations and regions, also the European Union (EU), are currently making large investments on industrial and academic research to attain competitive advantages. Their contributions to new technologies and new methods with the ambition of increasing flexibility, sustainability and innovation of industrial production poses a challenge to Sweden's competitiveness - a challenge that has to be met quickly and forcefully. To overcome this, academic, industrial and institutional efforts must be directed towards the same goal. This co-operation should be based on a common long-term strategy where industry, academia, and funding agencies agree on important priorities.

Several important challenges for the future's Swedish production scene have been identified [1]. Some of the identified areas are the need of a sustainable production, the level of flexible production, the role and interaction of humans in production systems, the use of digital & knowledge-based technologies for decision support and analysis, and the importance of parallel development of innovative products and production systems. The on-going globalisation poses, therefore, a huge challenge which brings both possibilities and threats. Today's technology and methods are not sufficient in order to gain advantage of the possibilities and/or solve the problems created by these challenges. Long term co-operation between industry, academia and research institutes is necessary to increase the competitive edge of manufacturing companies.

On the other hand, the collaboration between industry and universities is not a new phenomenon. The universities in Sweden have had the task of implementing Triple Helix, cooperation between the academia, the industry and the government, for some decades now. But to be truthful the universities have mostly focused on informing the surrounding society about their activities, instead of building up cooperation that includes all the partners. Therefore, the establishment of a more formal and effective collaboration is still a goal to pursue, and taking into account the challenges, it is something that has become more important over these past years for all the parties involved.

Additionally, according to Garrick et al. [2] the industry has recognised the importance of lifelong learning due to the increasing need for innovation and the fierce competition on the global markets. But, nevertheless, industry wants to see a more direct correlation between their investment in learning and improvements on individual and corporate performance. Classroom based training, although still useful, is no longer enough to deal with the new demands for learning at work. New times and challenges require in this case, new ways for continuous learning.

In a knowledge-based economy, learning becomes extremely important in influencing the fate of individuals, firms and national economies. Human capabilities for learning new skills and applying them are keys to successfully absorb and adapt to the profitable use of new technologies. Properly-trained researchers and technicians are essential for producing and applying both scientific and technological knowledge. In a knowledge-based economy, the academic world must balance not only its roles of knowledge production (research) and knowledge transmission (education and training) but also its third function, consisting in transferring knowledge to economic and social actors, especially enterprises, whose role is to exploit such knowledge. Economies are putting an increased emphasis on developing linkages between the academic world and the private sector in order to speed knowledge diffusion. In the case of higher education, university/industry collaborations bring with it opportunities to increase the relevance of the university's educational mission and to stimulate new research directions [3].

There are, as seen, many reasons for forming an industry-university collaboration [4]. These reasons include fulfilling an organization's education mission, accessing education and training resources, gaining competitive advantages, addressing business growth, achieving cost savings, enhancing organizational reputation, increasing revenue, accessing research and tool resources, and providing a staffing source.

Nevertheless, the focus in the academic world is placed on generation of knowledge, with all its rights, but this emphasis leads many times to that the academic world struggles with building up and sustain a fruitful relations with the Small and Medium size Enterprises (SME). Big companies usually have the needed infrastructure to be in contact with the universities and establish different ways of cooperation, but neither the SMEs nor the universities have well developed infrastructures to define and maintain fruitful relations between each other. This leads to a general view among SMEs that the university is a resource that is far away from their needs and/or reach. This highlights the importance of finding an

infrastructure and/or agency that promotes the needed bounding of interaction and communication between the academia and SMEs.

According to Abramo, et al.[5] the university–industry collaboration brings together individuals from two distant worlds: public research institutes and private industry are characterized by highly divergent missions, organizational structures and management systems. The term “ivory tower” [6] gives an image of the limited permeability of universities to the external world, including to demands for new knowledge that might arise in industry.

Several cases of successful university-industry collaboration are presented in the literature. Interesting is that in a number of cases an intermediate agency is operating with the aim of closing the gap between the academia and industries. This agency has a good understanding of the nearby SMEs needs and has the resources to maintain a fruitful link to the academia. This is the case of The Lean Advancement Initiative (LAI) at Massachusetts Institute of Technology (MIT) which enables enterprises to effectively, efficiently, and reliably create value in complex and rapidly changing environments [7]. Another example of an agency working for the regional industry is the North East Productivity Alliance (NEPA) in the United Kingdom [8] which aims to improve the productivity of regional companies to make them globally competitive.

### 3 COLLABORATION BETWEEN INDUSTRY AND UNIVERSITY

#### 3.1 Collaboration background

The region of Skaraborg is located in the south west of Sweden and around 256.000 people lives in the region. Approximately 300.000 people work in the engineering industry in Sweden, 2.400 companies are in manufacturing and 1.100 in services. Most employees, 70.000, in the manufacturing companies can be found in Västra Götaland where the region of Skaraborg is included [9]. This paper describes the collaboration between three stakeholders with the aim of increasing the competitiveness of the manufacturing industry in the region of Skaraborg in Sweden. The three stakeholders are:

- **Skaraborg´s manufacturing industry:** In the region of Skaraborg, the manufacturing industry is divided in different sectors mainly companies in the wood, automotive, engineering, electronics, automation and food. Companies are predominantly SMEs and there are around 850, meanwhile the big companies are just few. Small and medium sized companies are important components in the Swedish industry structure. Swedish manufacturing industry normally functions in long value chains, where the larger companies work together with many small suppliers [1].
- **Industrial Development Center in the region, IDC West Sweden AB:** The aim of IDC is to stimulate knowledge transfer and collaboration between companies in Skaraborg, leading to increase the competitiveness. It´s a nonprofit agency financed by public funding (European Union and local Swedish Governmental organisms) and is owned by more than 100 companies.
- **University of Skövde:** The University offers education to students and industry professionals and enhances the research related to the industry´s needs. The University of Skövde is a public university located in south-west part of Sweden in the region of Skaraborg. The main education and research areas are oriented to engineering and technology, computer science and technology, nursing and natural science. Other subjects taught at the university are behavioral science, economics and social science and media and humanities.

Starting from the foundation of IDC, the University of Skövde has had an active part in the development and operations of IDC. This close collaboration started with the ambition of securing higher competence to the IDC companies. When the global economic crisis hit Sweden in 2008 the scope changed. Sweden has always been dependent on its exporting industry and therefore highly affected by the economic situation of its main international markets. This dependence has increased over the last decades. This means that any global financial crisis combined with a severe international economic downturn has a substantial impact on the Swedish economy [10]. In the context of the 2008 crisis, the University of Skövde and IDC decided to work on a closer relationship. The aim was to maintain and develop a global, profitable, competitive and wealthy manufacturing industry in the region and reaching this aim would contribute to retaining competence and future job places. Considering the important number of SMEs in the region, IDC is a key stakeholder for these companies in order to help them access to the university´s services and resources.

## 3.2 Collaboration process

The collaboration process follows a pre-set number of steps. Despite a fairly standardized process that it is used with all the companies that have enrolled in the IDC program, then work done within these steps is very diverse depending on the unique needs of the enrolled company.

This process puts its focus on one step, elaborating short-term measurable actions, but at the same time taking into account what the company has defined in their strategic plans for the long term status and its actual situation. If the company doesn't have a long term plan or vision, the consortium helps them in the development of such plan.

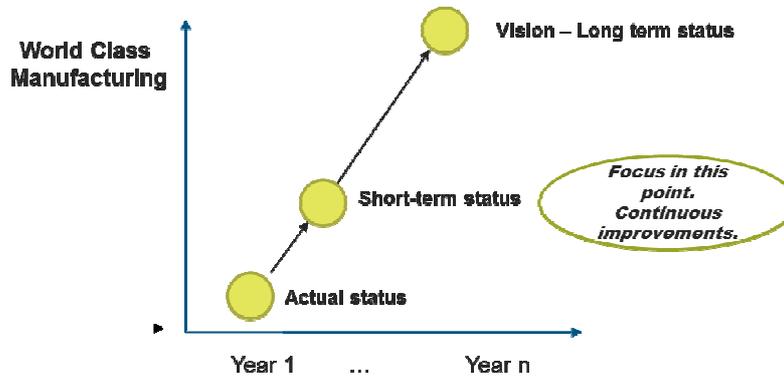


Figure 1: The focus point on the process.

All activities are aiming at giving companies the prerequisites, the means, and thereby the capability for taking the next step to a higher degree of competitiveness. This is done through identifying the company's present status and in a structured manner increasing the overall performance of the company to make the continuous steps.

The overall simplified process is the following:

- **Step 1 – Presentation and commitment:** IDC contacts the company or vice versa and after a formal presentation of the process, a long term commitment is required from the company. Usually this company is a member of the IDC group but also non-members can contact IDC to start the process.
- **Step 2 – Analysis:** A company analysis is made in three blocks: measurements, revisions and recommendations. All teaching staff at the university's manufacturing engineering group takes regularly part in this process step, as contributing resources and observes, IDC is always taking the lead. A field study is made analysing the production system and the efficiency in the different organizational processes.
- **Step 3.1 – Forming improvement program:** Before continuing with the process, the company needs to sign a collaboration agreement, since from this step and forward the process phases the most time consuming stage. It is therefore important to ensure the commitment of the company to the process. For an IDC non-member company, this is when becoming a member is suggested.

At this step, the company needs to define their goals and schedule their improvement program, including prioritization of required activities. Some major issues are identifying the main process, the needed organization for running the process and the demanded level of competence. A vital issue is to define the target for overall improvements, including the score card. Furthermore, an educational plan covering the company's need is made.

- **Step 3.2 – Running improvement program:** During this last step the improvement program is run. Taylor made education can be a part of the improvement program, which demands the University of Skövde to take an active part in this part of the process. The education program is modular based, industry oriented and adapted to the student type e.g. managers, team leaders and operators. Beyond tailoring the content, the form and geographic arena is, within limitations, adapted to the companies' need. The participants discuss their company's problems during the classes and the teacher helps them to use their newly received

theoretical background, contributing with his own industrial experience, to illustrate feasible solutions.

This step that is usually extended over one year period includes on site coaching and revisions. These activities give the possibility to see whether the program is on track and/or to identify additional activities needed. The revisions control four chronological steps: The operations system is in place, the operations system works, the trend is correct and finally, the overall target will be reached.

After finalizing the process, the communication is maintained between the three stakeholders and continues for a considerable time. IDC offers continuous coaching services and the University of Skövde offers industry oriented education, participation on company convenient research projects (new products, new services or improvements in their processes) and the possibility for the company to offer thesis projects for engineering students within the industry. Fig.2 below presents the different steps, stakeholder participation and common lead time for the different steps.

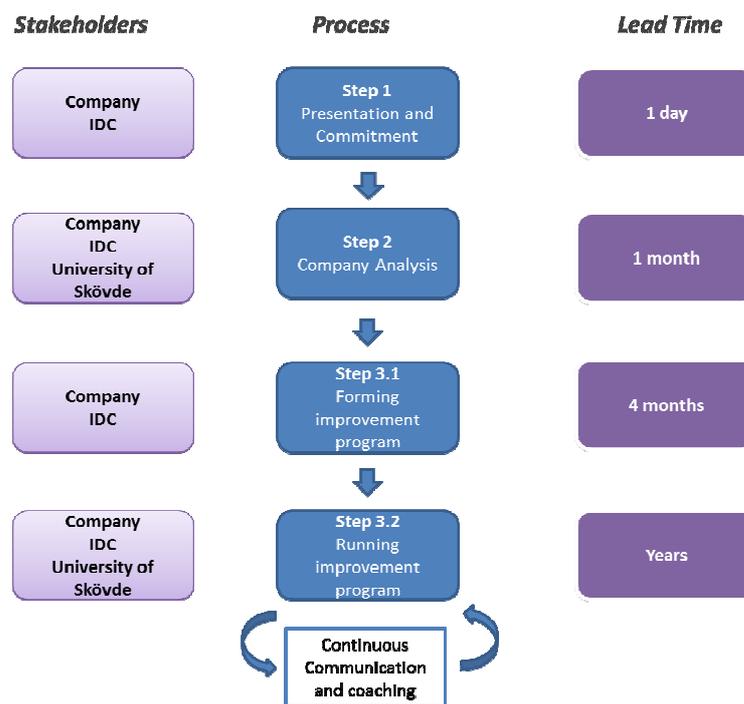


Figure 2: Collaboration process steps, stakeholder participation and expected lead times.

### 3.3 Case study: Nimo-Verken AB

Nimo-Verken AB is a company that has followed the earlier described process. Their participation started in late 2009 and is still on-going. The company is one of the main product developer and manufacturer of laundry room equipment of Sweden. Some examples of their products are drying cabinets, iron cabinets, cabinets and zincs. The company has been leading the restructuring of this branch and have therefore been growing organically as well as via procurement of additional brands. Nimo-Verken AB is a SME, with 85 employees.

Here follows a brief description of the activities that have been conducted together with Nimo-Verken AB:

- First analysis in early 2010, which included the active participation of both IDC and the University of Skövde.
- The improvement planning program phase ended with a kick-off in December 2010.
- The improvement program is currently running, and revision three to be completed late in October 2011.

Nimo-Verken's past and history represent an interesting background to illustrate the advantages with the currently proposed process and collaboration. The company has been involved in a number of initiatives with the aim of reaching a more efficient way of working and a process oriented quality

system. The company has attained quality certificates such as ISO 9000, but the gained certificate has mainly indicated that there is a system, not that they work according to that system. There were a discrepancy between the system and the operations.

The different embarked initiatives were never successful. They did not prevail and didn't really changed anything; there where viewed as merely new projects with an ending date, not as a continuous improvement process with the aim of changing the behaviour or their way of working. This meant, naturally, that the company was quite difficult to convince of the future benefits and outcome of this proposed collaboration. In order to overcome this scepticism was the board of directors invited to take part of the process details and early results. The purpose was to create a better understanding for the support that the company and the managing director were in need of acquiring the long term benefits expected for the company. The final strong commitment of the company became as a result of this initiative.

The company decided to educate all their employees in Lean Manufacturing during this period. The University of Skövde lead this part of the process. The development of the education modules was performed in a joint team between the University and the industry, including the production manager at Nimo-Verken. This process was supported by the fact that the University participated on site during the early analysis and could identify the company's educational need through their own eyes. In addition, key staff got a more profound education of Lean Manufacturing. The Managing Director himself did participate in the pilot education in Lean Management.

The company is representative for the companies in the region in terms of size, structure and operations. For instance, the company has both development and manufacturing departments.

The company's effort and commitment gave fruitful results, the company's profit jumped twofold during the period between April 2009 and April 2011. The turnover increased 8,3% during the same period. Have in mind that despite that the global economy affected the turnover and growth during this time frame, i.e. the net sales, dropped by 5,9% from 2009 to 2010, did the result increased during the same period by 7,7%. This increase was attained without firing any of the personnel. Naturally one could argue these improvements could be the result of other changes and are not solely due to focus on efficiency during the last year. However, the main and only activity in the company that has been added the last year compared to previous years is this described work in this article.

#### **4 DISCUSSION AND RESULTS**

The last two years have been a learning process for the three stakeholders. The process has been improved and a strong network has been established.

More specifically, the collaboration has given each stakeholder different benefits. The industry of the region has had the opportunity to develop improvements in their processes and operations and give applied education to their employees in collaboration with experts. Furthermore, the actions and improvements made in the industry give results in short term but also a long term impact is expected. The coaching and education is continuous over time, this collaboration is not a point input action, instead it helps industry to follow the improvement process supporting time and again. Giving IDC's experts the opportunity to monitor and guide the process together with the company.

Additionally, the industry is part of a network where they can share their projects and problems with other companies in the region. This is part of IDC mission, to help the industry of the region and increase their competitiveness.

From the University point of view the lecturers are in direct contact with industry so they can easily explain theories with recent example from the real world. All lecturers at the university have also had the opportunity to assist IDC in the process of analysing the companies and by doing so they got a snap shot view of the production situation and knowledge level at SME's today. Another benefit of this collaboration is that the industry is providing new students for the University of Skövde and new research areas and projects. And this collaboration is allowing that some of the students of the University can do their thesis in the companies so they are gaining experience and enriching their Curriculum Vitae.

More than 140 company analyses have been performed, more than 2.500 employees have been trained from 120 companies, and a coaching process has been developed in more than 80 companies. The following table present the total number of companies, participants etc. within the different categories starting from fall 2009 until august 2011.

Table 1: Summary of results.

Step description	Number
<b>Company Analysis</b>	141
<b>Companies in Improvement program</b>	84
<b>Companies in education program</b>	120
<b>Participants in education program</b>	2.508

Although over the past two years an intensive effort has been done to improve the process, the authors believe that the analysis as well as the improvement program steps can be made even more efficient, leading to a potentially higher number of companies reaching level 3.2 on the process, with IDC's same level of funding.

The lessons learned from this work are mainly the following:

- **The commitment of all the stakeholders is mandatory:** At the start of the collaboration process, all the stakeholders must agree on their obligations and provide the resources that they are going to need during the process. This is a crucial agreement, if one stakeholder fails to fulfil his responsibilities, the process fails. The commitment has to be anchored at all levels in the company and at the university.
- **A good process structure and standardized packages are needed:** Before the initial step, it is necessary to have a clear structure of the process that is going to be followed, which has been agreed with the company. Also standardized packages for coaching the companies are needed, even though there is room within these packages for handling with company's specific particularities. These standardized packages have been designed so that the company would be able to follow them without continuous monitoring.
- **A free process but a symbolic fee:** The coaching and the education are free of charge for the companies. However, the time for participation in the education, is funded by the company. A symbolic fee is charged along with the agreement signed between the company and IDC, to ensure that the commitment from the company is for real.
- **Industry oriented education developed jointly:** The education has been developed jointly between the University of Skövde and IDC, giving a deliverable that is truly adapted for the industry. When the employees have gained knowledge and insight on production philosophy, methods and tools, practical hands on experience gained in classroom simulations, their attitude towards system improvement becomes much more positive. This attitude improvement and the knowledge gained give the foundation for setting of the true improvement work at their respective companies.
- **Flexible education:** Taking into account that the education is more or less tailor made for the industry, the University needs to have modular approach in order to adapt the education package given to the different type of students.
- **The coordination between the industry and the university is a key point:** IDC and University of Skövde have mutual aims, they share the same view on production system development, and they use the same language and terms. This contributes to a strong collaboration.
- **Physical proximity:** The University and IDC are located in the same building which helps in maintain a good communication and coordination of the programme. The proximity gives many occasions for formal and informal meetings, which improves the process and the information sharing among these partners.
- **Feedback for future projects, research and education:** An important benefit for all the stakeholders is the network that arises from this collaboration. It gives opportunities for developing future projects together. An additional benefit is the mutual insight gained by the partners and the possibility to identify future needs.

## **5 CURRENT AND FUTURE PROJECTS**

The work of this consortium aims at strengthen the competitiveness of manufacturing industry in the region. In order to measure whether the work have a long term benefit and which parts of the process were particularly beneficial for the companies a research project that monitors the program started early 2011. The research project tries to identify the impacts the program has on companies both on an overall level and in terms of selected indicators. These indicators will indicate whether the companies' competitiveness has been reinforced and hopefully highlight the relative importance of the different project activities.

In order to support further development and improvement of the project intervention and methodologies, the research project will examine if there are correlations between company factors and project activity's outcomes. Following the same line of thought, the research will also try to contribute to a better understanding on what activities and combinations of activities have the best impact.

Different research methods will be used in order to strengthen the outcome of the study [11]. A questionnaire will be used to find out about the individuals experiences of the intervention and semi-structured interviews will be conducted with selected individuals in a sample of firms. Secondary data from government statistics, selected key performance indicators, will be collected and used for data mining in order to find out if there is some correlation to the activities made in the intervention.

This consortium has concurrently been part of a Lean Learning Academy project of the Lifelong Learning Program, funded by the European Union within the Erasmus. In this project a set of course modules and a lean game has been developed in collaboration with the industry. A collaboration has been formed between Lean experts from a number of universities and highly experienced companies in Lean manufacturing in five different countries (Belgium, Poland, Sweden, Romania and Portugal). The goal of this cooperation has been to develop a state-of-the-art training programme consisting of a Lean production simulation game that is alternated with 16 on-line course modules on different Lean topics. This project has been developed on the one hand to satisfy the need for education and training of Lean manufacturing principles in companies and on the other hand to improve engineering students' employability [12].

## **6 CONCLUSIONS**

In a knowledge based economy, manufacturing industry has to continuously improve their operations, processes and develop their employees in order to remain competitive in the market. Furthermore, to overcome the challenges that this new era brings on, academic and industrial goals should be based on a common long-term strategy.

A collaboration network has been created between IDC, the University of Skövde and the manufacturing industry in the region of Skaraborg, involving not just big companies but also SMEs. This collaboration has been brought on with the aim of increasing the companies' and the region's competitiveness.

There are significant opportunities and benefits in collaboration between industry and academia. For instance, knowledge transfer is done in both directions. The industry gains modern days manufacturing methodology, tools and principles. On the other hand, the academia gains insight in companies' current situation and research opportunities. In order to achieve these benefits it's important to emphasize the high level of commitment required by the partners involved. This commitment is mainly what makes the process successful, although the flexibility, common aims and good communication between the stakeholders are all very important. It's preferable if the involved staff is composed by people with an industrial background. This background improves the education and understanding of the industry's needs.

This process is not just an idea, it has been tested and developed during the last years in over one hundred companies and the authors believe that this is a methodology that can be applied successfully in different regions and countries.

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