International Journal of Case Method Research & Application (2012) XXIV, 4
 ISSN 1554-7752

LEARNING TO LOVE AMBIGUITY: AUTHENTIC LIVE CASE METHODOLOGY IN INDUSTRIAL MANAGEMENT EDUCATION

Pär Blomkvist
Lars Uppvall
Royal Institute of Technology
STOCKHOLM, SWEDEN

Abstract

The authors discuss the application and development of case methodology in Industrial Management education on a master level. They state that engineering Bachelor students can handle large workloads, are analytically skilled and trained in problem solving but also that industrial managers do not primarily solve problems, they *formulate* problems. The authors use case-based learning to enhance students' transition from problem solving to problem formulation. But traditional case methodology is not enough: authentic live cases are a necessity when trying to turn problem *solvers* into problem *formulators*, when learning to love ambiguity.

KEY WORDS: Case learning, authentic case methodology, industrial management, university education, master program, ambiguity

INTRODUCTION

In this paper the authors discuss the application and development of case methodology in the Industrial Management Master Program at the department of Industrial Economics and Management at the Royal Institute of Technology. The Industrial Management two-year master program (launched in 2010) admits 80 engineering Bachelor degree students per year (e.g. Mechanical Engineering, Computer Science, Material Design). Students come from BSc programs at KTH (as parts of six 5-year Engineering program) and through an international admission (as a stand-alone Master program). The authors will discuss the whole master program, but focus on one specific course where case methodology is especially prominent: Change Project in Industrial Management (CPIM).

The master program consists of eleven compulsory courses in the area of Industrial Management. Nine courses are exclusive for the program students and are interconnected, designed for progression and matched with the learning objectives of the program. The program could be described as covering most of the primary and supporting activities of Porter's well-known value chain model [Porter, 1980], including leadership and the strategic and the industrial dynamic perspectives. However, equally important is that students should be able to manage change based on a "systems perspective" (see below). The primary goal of the IM-program is to shape engineering bachelor students into industrial change managers able to handle complex industrial change processes.

Traditionally, engineers are professional problem *solvers*. Problem solving is a core capability of every engineer, from any university. Technical problems are typically approached by applying mathematical models. Engineering students are often highly skilled in recognizing technological problems and approaching them by numerical models or simulations. As a consequence of this – especially in an

educational environment – they tend to value accurate and detailed quantitative results. They do not love ambiguity!

However, engineering students in the area of Industrial Engineering and Management are typically faced by an extended frame of challenges when the scope of problems are to include issues related to management of R&D, production, and marketing as well as decisions related to strategy and leadership. Students facing such extended scope of challenges need to be well grounded in technical problem solving. In addition, they need a new palette of knowledge and skills in order to approach the complexity introduced by the qualitative context of management and strategic decisions making – a context that seldom offers Newtonian approaches or distinctive, undisputable, numerical answers to a given problem.

The students in the program can handle large workloads, are analytically skilled and trained in problem *solving*. But industrial managers do not primarily solve problems, they *formulate* problems. The program goal is to enhance the students' transition from problem solving to problem formulation.

The pedagogical foundation for the master program is gathered from the area of "Problem Based" Learning (PBL) [Cheong 2008, Spence 2012, Barrows and Tamblyn 1980]. PBL fits very well in case-based learning methods and the bottom line in the version of PBL used in the program is aligned with the goal of turning *problem solvers* into *problem formulators*. The authors insist on presenting the students with vaguely structured problems and open ended questions. Why? Because ill structured problems prepare students for a managerial position. Outside school, no one will give you a structured and precise problem to solve. There is seldom only one correct answer to real world problems. Training in learning how to deal effectively with vague problems should start in the education context.

In this paper the authors will argue for the advantages of case-based learning, and for the need for a progression beyond pre-developed cases. In particular, an expansion of the context richness in the cases used – a context that the students can "see – feel – change" [Kotter and Cohen, 2003]. Traditional case methodology is not enough to reach the learning objectives of a master program in Industrial Management. The authors argue that authentic *live cases* are a necessity when trying to turn problem solvers into problem formulators, when learning to love ambiguity.

AUTHENTIC LIVE CASES IN THE IM MASTER PROGRAM

Learning activities within the Industrial Management master program must encompass elements that bring *ambiguity* to the problems that challenge the students. This is an important aspect in all types of management education. However, in a situation where students come from a learning environment where numeric precision has been highly rewarded the authors believe that prompt introduction of ambiguity within the learning activities is particularly important.

The use of cases and case-based learning is one of the most practiced methods to enhance student's ability to reason, make decisions, and introduce ambiguity in order to prepare for the uncertainty of professional work-life [Marseth, 1996]. Christensen and Hansen have expressed the importance of cases in business education with precision:

> "A case is a partial, historical, clinical study of a situation which has confronted a practicing administrator or managerial group. Presented in narrative form to encourage student involvement, it provides data – substantive and process – essential to an analysis of a specific situation, for the framing of alternative action programs, and for their implementation *recognizing the complexity and ambiguity of the practical world*." [Christensen and Hansen 1987, p. 27, our italics].

Case-based learning is nothing new in management education. A pioneer and a forerunner in case-based learning and teaching is Harvard Business School that grounds their entire MBA curriculum in the HBS case method and puts case method teaching as the number one success factor of its MBA education [HBS MBA, 2012].

From a pedagogical point of view, case-based learning offers several important types of leaning objectives to be addressed. For example, taking the SOLO taxonomy [Biggs and Collis, 1982] – describing different intended outcomes of education – one can argue that case-based learning could support both of the taxonomy's highest levels of qualitative outcomes – "Relational" and "Extended abstract". However, business-oriented cases could typically be seen as learning activities aimed for the second highest category of the SOLO taxonomy (Relational), supporting students' abilities to compare/contrast, explain causes, analyze, relate, and apply.

Although, if the case assignment have been given to students for preparation in groups before class-room interaction, the intended learning outcomes could extend also to include several important skills related to management education. Examples are: application; the role of theory in the decision making involved in the case; the role of teamwork and collaboration; critical thinking; creativity [Biggs and Tang, 2007, p 138].

These aspects emphasize the importance of how case-based learning is implemented into the learning environment and the pedagogical context. Several important pedagogic ideas and inventions could therefore be incorporated into the case-based learning approach, such as Problem-Based Learning, as the authors have done in the IM-program, formative feedback [Black and Wiliam, 1998], peer-instructions [Mazur, 1998], and examination portfolios [Biggs and Tang, 2007]. Every educational situation needs a thorough analysis of what learning activities are needed to obtain the specific learning objective. This is a well-recognized argument in the literature on pedagogical methods for higher education [Biggs and Tang, 2007]. Still, a thorough implementation founded on constructive alignment (a clear alignment between learning objectives, learning activities and examination) using advanced pedagogical methods is complex and demanding. The development and implementation must therefore always be followed by reflection and structured student feedback [e.g. Dunkin and Precians, 1992]. It comes as no surprise, that highly-renowned educational institutions often self promote through detailed descriptions of how case-based learning is implemented in their educational programs followed by testimonies by both students and teachers. Among others, HBS's is again an excellent example [HBS MBA, 2012].

However, the classic case-learning approach (e.g. represented by the implementation at HBS) has recently been debated and the limitations that have been brought up are particularly valid for management education. Two aspects, where the second builds on the first, could be condensed from these discussions. First, the typical cases-based learning approach, using a detailed teaching approach around pre-developed cases, tends to be subject-narrow if used as the dominating teaching activity. With this approach there is a risk that analysis, solutions, and discussions will be more centered around theoretical concepts than what effects the business context have on the decision process. Hence, the outcome could be described as a deepening of students' declarative knowledge; missing out much of the functional knowledge, which is often a core objective in management education [Biggs and Tang, 2007]. Secondly, the issue most intensively discussed is whether business schools have failed to incorporate enough coverage of business ethics and a deep understanding related to real-world responsibilities that comes with the positions that their students aiming for – a discussion leveraged by the focus put on the financial sector during the latest financial crisis. In *Rethinking the MBA* [Datar, Garvin & Cullen 2010] the authors argue that the case-based approach at HBS has evolved to "problem sets, narrowly designed to teach technical skills" instead of to develop skills to apply in a "broader company and industry context". There is also a number of trends associated with the limitations of pre-developed cases described above. One is the pedagogical approach where students develops and write the case [e.g. Bengtsson and Asplund, 2008]. By this approach the students encounter a more vivid reality and the whole process of writing the case adds several learning opportunities compared to the pre-written case approach.

In spite of several reported initiatives of improving the case-based learning approach, for example, by case writing [Bengtsson and Asplund, 2007, 2008] and live case studies [Honeycutt Sigler, 2006], the literature seems to be lacking a clear approach on how to develop the teaching tradition in case-based learning in order to incorporate more of real-world context supporting learning objectives related to the practice of a subject area. This argument is particularly valid concerning approaches that go beyond a single course, aiming at learning objectives for entire programs and degrees.

In short, case-based learning has been a central pedagogical tool in management education for many decades. However, recently there have been voices raised against narrow teaching methods associated with business-oriented cases. In this paper the authors will discuss the progression in the scope of a master program in Industrial Management from teaching students by pre-written cases to the introduction of real-world cases. The authors discussion addresses the need of real-world complexity and ambiguity as a part of the learning context – the opportunity for students to "see – feel – change" in relation to the challenge that they are approaching – and to describe how some of the pedagogical instruments that has been implemented to facilitate and assess this type of learning activities.

MITIGATING DEMANDS FROM ACADEMIA AND INDUSTRY: THE IM-SYNTHESIS

There are two important objectives guiding the Industrial Management (IM) master's program. The first objective is to prepare students for future managerial positions within production development, project management, R&D management, marketing, etc. in technology-intensive industrial organizations. Secondly, the objective is to educate students according to the academic standards of KTH and prepare them for the possibility of future doctoral studies.

The authors like to define the two objectives as "customer demands". In their interpretation the program management has two "customers" to satisfy: *Academia* and *Industry*. In this section the authors will discuss how they have addressed demands from these two clients, by presenting six guidelines that have been important in designing the program. From academia: *Learning objectives*, *Constructive alignmen*t and *Science based results*. From industry: *Change management*, *Systems perspective* and *Business results*.

DEMANDS FROM ACADEMIA

Learning Objectives

During recent years, state authorities and university boards have increasingly focused their attention on formulating explicit learning objectives (outcomes) for degrees and educational programs. From the perspective of the IM master program, this means that the national demands on the master's degree have to be covered in the specific learning objectives for the program. These demands are formulated in three categories: knowledge and understanding, competence and skills, judgment and approach. The specific national demands under each of these categories are then adapted to the specifics of the master program. Finally, each course and its content are mapped against the program's learning objectives in order to create an effective educational program where the learning activities are executed and assessed progressively.

In the authors program, they use the learning objectives as a tool for systematic program and course design as well as quality assurance. Firstly, they have translated the general learning objectives to fit the program, and secondly, they have developed course-related learning objectives for each course. The guiding principle has been "constructive alignment" (see below). All learning objectives are not reached in every single course. But when completing all the courses in the program, the students have reached the master level in Industrial Management relating to "knowledge and understanding", "competence and skills" and "judgment and approach".

Constructive Alignment

Actively focusing on learning objectives, as mentioned above, requires a systematic framework for creating prerequisites at the program level for activities and examinations being in line with the learning outcomes of the program. The framework used is *constructive alignment* [Biggs and Tang, 2007], perhaps the most established pedagogical concept to support such an integrated educational structure. In designing the IM master program, the concept of constructive alignment has been the central tool for development and coordination. Having learning objectives covering knowledge, skills, and the ability to evaluate requires a thorough mapping of course activities and examination forms in order to be effective.

But constructive alignment has not only been the framework for program and course development per se. The authors have also worked hard to align faculty competence – in both subject areas and teaching methods – to the learning objectives of the program.

Results Based on Scientific Theory and Methodology

University education should teach scientific theory and methodology. But from the authors previous experience, especially in master thesis teaching, they have encountered a conflict between industry and academia when presenting results. Students often report that their company is not at all interested in academic theory and methodology. Industry is supposedly concerned with straight-forward and applicable results that can be immediately implemented. These contradicting goals often make students perceive a huge difference between the "consultancy report" and the "academic paper".

In the IM program the authors have worked hard to overcome this conflict. From day one, in the first course, the students are encouraged to embrace scientific theory and methodology. The authors argue that the academic paper is the "mother of all papers". If you are supposed to deliver a Powerpoint presentation, an executive summary, a consultancy advice – in whatever form it may be – the structure and the logic of the academic report is of fundamental importance. Academic demands on structure, methodology and theory are vital to ensure quality, reliability and validity in any situation. The authors argue that the conflict between the academic paper and the consultancy report is an illusion. The IM students must understand that knowledge of scientific methods, content, and writing brings important added added value to the customer.

DEMANDS FROM INDUSTRY

Change Management

One of the most emphasized prerequisites for competitiveness in contemporary management literature is organizations' and individuals' abilities to handle change (e.g. Kotter and Schlesinger, 2008). Input from the program's industrial network also supports this – today's industrial companies are not suited to be studied by static approaches. Instead, dynamic environments imply (e.g. caused by speed of new technology development and globalization of markets) that one must considerer *constant change* as a condition for the understanding and analysis of industrial and technology intensive organizations.

Systems Perspective

The next demand identified from the perspective of the industry is based on the need to approach challenges from a *systems perspective*. Arguments from both theory as well as practitioners are unanimous in that integrated business models, combinations of product and service offerings, decentralized, and flat organizational structures in today's business environment require a system perspective when dealing with change. Throughout the program the students are faced with change processes on three system levels:

1) Individual (e.g. leadership)
2) Functional (e.g. supply chain)
3) Industrial (e.g. industrial dynamics).

Therefore, the authors promote IM from a systems perspective, arguing that the individual, functional, and industrial levels and their systemic interrelations must be considered when approaching industrial and technology intensive organizations. This is simply because static linear processes, decoupled from each other, are rare exceptions in the future working-life.

Results Easy to Implement and Useful for Business

The authors start the master program by acknowledging the obvious fact that clients from industry really need results that are easy to understand, possible to implement and useful for business. Then they point out the equally obvious fact that these results must be based on a sound investigation, a clear methodology and that the argumentation must be logical, unbiased, theoretically justified, etc. They conclude by claiming that the academic report is the foundation for all other results presentations. As touched on above, the students are often confused by the perceived difference between the academic paper and the way industry wants the results presented. Throughout the IM program the authors try to mediate in this conflict by arguing that the conflict is an illusion. Thus they stress the need for students to develop useful and valuable results for the industrial clients. And, that the best way to do this is by a thorough investigation based on sound scientific methods.

THE IM-SYNTHESIS

Based on the authors understanding of "costumer demands" from academia and industry, the ambition to mould problem solvers into problem formulators and the earlier discussion on case methodology the authors have formulated a synthesis guiding the IM program and especially the design of the last course (CPIM). Formulated in one sentence the IM synthesis looks like this:

An authentic industry case run like a consultancy project through prototyping seminars resulting in a consultancy report/presentation based on an academic paper and examined by a portfolio model.

CPIM: GOING LIVE

In the final course of the program, before the master thesis degree project, students are introduced to a real company change assignment. In this case-based course the students are approaching the full-blown complexity of authentic challenges within IM. The academic report represents the central communication tool and its quality assurance aspect in IM is thoroughly explored. PBL is here elaborated to its most explicit way and paralleled with the introduction of "prototype seminars" where continuous feedback is enhanced.

The project is run in association with industrial companies and focus on current, or future, challenges that the companies have identified within their operations. During the 20 weeks of the course, students work independently in teams ("consultant teams") starting with an introduction to the identified problem/challenge/efficiency improvement presented by the company. Thereafter, the teams frame the scope of the mission and approach the challenge based on primary and secondary sources of data, literature studies, and benchmarking studies. Finally, the teams present a comprehensive analysis and a work plan describing how they suggest that the change project will be implemented in the organization.

The main content of the course is related to the change project. Lectures and seminars, where theory is presented and discussed, are given concurrently and integrated with the students' own work on the project. Particular attention in these activities is put on leadership/change management, organizational development, the interrelation between different theoretical areas of Industrial management (in order to emphasize the systems perspective) as well as research-based and methodological approaches related to the analysis of industrial and technology intensive organizations. The central learning objectives of the course are related to increasing students' abilities in order to transform their knowledge into value-creating activities in industrial and technology intensive organizations.

As mentioned learning objectives has been used actively as a tool for course design and quality assurance. Before explaining how they executed the course Change Project in Industrial Management (CPIM) the authors present the specific learning outcomes:

- Analyze and provide solutions to complex and authentic challenges within the area of IM with a focus on product development, production, or marketing.
- Analyze and evaluate changes within industrial and technology intensive organizations based on a systems perspective.
- Critically evaluate theories and models within the area of IM.
- Manage and being a part of a project team with different roles and responsibilities.
- Rate other students' achievements and results from their work as well as provide feedback.
- Communicate one's own standpoints, orally and in written form, towards companies as well as the course management.

PREPARING THE STUDENTS

For the students to be able to cope with the authentic live case in CPIM they need to be prepared. Thus, two of the courses are specifically aimed at the *program* learning objectives, covering the whole area of IM, with a strong focus on case work. The very first course in the program, Perspectives on Industrial Management (PIM), is a "crash course in mind-shifting" and focus on the transition from problem *solving* to problem *formulation*. In the second course, Industrial Transformation and Technical Change (ITTEC), the authors focus on the academic paper, theoretical concepts used as practical tools and oral presentation techniques. In both, they encourage the students to act as industrial consultants formulating an authentic real-world problem for their costumer, collect data by a study visit, interviews and literature and present a solution in the form of a report, an oral presentation or an executive summary – based, on the academic report (the authors introduce a template that the students use through the program). In the PIM course they use two Harvard cases and one authentic industry case. There are seven feedback loops (prototyping) and an introduction of the examination

portfolio based on learning objectives. The authors have a strong focus on Problem Based Learning (PBL), communication skills and capabilities.

EXECUTING CPIM

As mentioned above the IM-synthesis can be spelled out and summarized like this: An authentic industry case run like a consultancy project through prototyping seminars resulting in a consultancy report/presentation based on an academic paper and examined by a portfolio model.

In the following section the authors use the headlines from their synthesis when discussing how CPIM was executed. They return to the objective of this paper and argue for the advantages of case-based learning beyond pre-developed cases. Traditional case methodology is not enough to reach the learning objectives of a master program in IM. The thesis of the paper is that authentic live cases are a necessity when trying to turn problem solvers into problem formulators, while learning to love ambiguity.

Authentic Industry Case

In line with the authors design and the size of the master program, 3-4 industrial companies are required as partners to the course. Most companies could be considered as "industrial companies". Students from the IM-master program should, therefore, also be prepared for a broad range of companies that need their competence. Hence, the authors interpretation of "industrial" is not equivalent with "large manufacturing" companies – let's say, "engineering" profiled companies like Ford or Volvo. The Swedish company IKEA is an excellent example of a company illustrating today's broadness of what could be labeled an "industrial company"; that is, a company with complex operation and a large demand for engineering and industrial management competence. This broad picture of "industrial companies" has guided the authors when approaching suitable partners for "change projects". In 2011, the partner companies had the following character:

Company A: Supply chain and logistics (Manufacturing)

Company B. Strategic purchasing (Food retailer)

Company C: Functional sales (IT-company)

All companies represent large industrial companies (Net sales >25 000 MSEK), two are global and one is pan-Nordic, and all have a strong demand of IM competence.

The student case projects focus on current, or future, challenges that the companies have identified within their operations. An additional requirement is that the possible implementation of a project should not be too far into the future; the authors argue that more near-term implementation date (e.g. six months to two years) enhance the likelihood of more detailed input to the change project. The focus of the case projects can vary from more strategic to functional. However, they must fit within the scope of the 20-week duration of the project and relate to one, or several, subject areas covered in the program. That is, development of new financial products for a bank will not qualify; while a financial strategy for an industrial investment will qualify.

All together, each team presents the whole scope of the project for the company representatives three times (problem formulation; mid-project reporting; final product). Two or more representatives in managerial positions attend these presentations. One of these is also the contact person towards course management. During the project, students visit the company several times. Planning, setting up meetings, interviews and other types of data collection have been important parts of the skills training. Students know that the access and quality of the processes will affect their empirical foundation in the final report. The authors also use secrecy agreements between the students and the companies. This is important for all parts, not the least for the sense of authenticity among the students.

From a course design perspective this structure has several risks. Things could change in the companies during the time of the course and contact persons can get new positions. In addition, interacting with a company could also be (too) demanding for students. Two measures have been taken by the authors to reduce these risks. One is that each project is required to conduct a benchmarking study related to the project. If resources are stressed at the company, the benchmarking part could be allowed to take a larger part in the students' projects (without limiting the ability of students to reach the learning objectives). The other is the role of the company coaches. Each group has a coach from the faculty with a close contact to the company representatives. This is a vital resource that helps both

students and the company in any matter or emerging problem. The coaches also evaluate the progression and results of the work from an industrial/company perspective.

Building the learning activities around authentic challenges within the partnering companies is, needless to say, the strongest aspect of authenticity in CIPM. The authors argue that few alternatives can offer similar opportunities for students to experience

the characteristics of "see – feel – change," related to change management [Kotter and Cohen, 2003]. However, authenticity is only part of the learning objectives of the course. In order to incorporate these activities along with fundamental requirements in higher education, such as critically evaluate theory and individual assessment many parts of the teaching toolbox have to be reconsidered.

Consultancy Project

To let the students work as management consultants for an industrial company; is that a relevant set up for considering the objectives of the course/program? Yes. Statistically, up to 50% of the students start their careers as a consultant (management, IT/management, technology/management). In addition, if they don't they will probably be buyers of consultancy services and, most important, the course demands a temporary project, so the line manager role is not valid in this setting – and the industrial challenge is the same.

There are no strict demands on roles within the project group. However, the authors require that the group always has one student assigned as the "group officer" who is accountable for the group's deliverables towards course management. Based on prior compulsory courses such as Team Leadership & HRM and Project Management, the students' basic toolbox for running a consultancy project has been obtained. However, the students are encouraged to develop the project organization, including different roles that their specific project requires. In addition, both the mid-term and the final examinations demand the students' theoretical and practical reflection. Along with the students' responsibilities and the demands on them to organize their work, another important resource is the availability of student facilities. Project rooms, preferably available on a 24/7 basis, are vital. This has been provided in this course, although, the authors believe that the development of a more advanced "management innovation lab" will further leverage student work and results.

One important factor to enhance this aspect of the project and the work in project teams is the size of the groups. In this project, both the scope of the project (the shared workload) and the number of individuals involved (7-8 students per group) force the students to organize their work. The group size makes it impossible to just divide the tasks and meet to put them together. Now the setup demands organization and coordination of the activities – an important learning objective of this course.

A lot of responsibilities are in the students' hands; therefore, teachers need to have an open approach to each group, and each student. Both free-rider and bullying/victimization are behaviors that the course management has to monitor and take responsibility to prevent. However, to design a course that leaves out demanding group processes would never qualify with the learning objectives in management education.

Having a visible receiver of the students' work – in parallel to the course management – is an important factor of authenticity. As usual, the grades are at stake in this course, but here also the impression of a potential future employer plays a role. Hence, the group dynamic is leveraged by the introduction of an industrial partner. The authors argue that this design generates very important activities for training of professional skills.

Prototyping Seminars

Traditionally, engineering education has been directed towards the ability to design and build a physical product. Being in a managerial environment where the material result of the engineering work is hard to identify, the authors have focused on tangible communication. The written (academic and/or consultancy-) report is the product and the authors encourage students to "show and talk" by enhancing communication skills (written and oral).

The discussion on the material quality of engineering work and education is not new. For ten years, the Vehicle Engineering program at KTH has used pedagogical frameworks such as CDIO (Conceive-Design-Implement-Operate) [Edström and Kuttenkeuler 2007, 2010]. But it has been difficult to transfer CDIO-concepts to other institutions lacking a clear focus on building technical artifacts:

> "The concept *design-implement experience* has often been too narrowly understood only as courses in which students build gadgets, mechanical artefacts (sic.). Transferring the idea to other disciplines is challenging, if faculty try to simply translate the *thing* that students build, to other contexts ("What should they design and build - a molecule?")." [Edström et.el. 2009]

Being in a managerial environment where the material result of the engineering work is hard to identify, the authors have focused on tangible communication and the proposition that the written report is the actual product. The authors argue, using the words of Edström et. al.:

> "…that the *aims of the learning experience* should be transferred to the context of the particular engineering program. Then the task is to create learning experiences which are similar to professional engineering practice, giving students an opportunity to experience a complete project cycle, with a hands-on approach. The aims are that students should integrate, apply and express disciplinary knowledge, and develop *complex* skills and judgment situated in the relevant engineering context. Such learning experiences can be designed for any engineering program, and for all stages of the education." [Edström et.el. 2009]

The practical setup is quite complex managing 80 students. As mentioned, the authors had three companies (company A, B and C) included in CPIM. Each company was assigned three student/consultancy teams (7-8 students each). Thus, they had a total number of nine groups (A1-3, etc.) investigating three industrial areas. To avoid free riding and at the same time maximizing learning they organized the prototype seminars in two categories:

Coach seminars: The three consultancy teams from each respective company were assigned a company coach from faculty to discuss common problems, factual details and practical matters close to the company and the industry.

Cross-section seminars: In these types of seminars the authors cut the groups in another way and arranged seminars for a cross-section constellation of groups: ABC-1; ABC-2; ABC-3

Each team got the same general assignment from course management: "You are to act as a consultancy team. Based on the assignment you get from your company: Define a problem that is not trivial. Suggest a plausible solution to this problem in a report."

The authors based the seminars on the notion of "prototyping": that you gradually build your project work through repeated mock up versions – prototypes. Inspired by Larry Leifer at the PIEP Workshop: *Changing Mindset, Improving Creativity and Innovation in Engineering Education*, Stanford University, 2010, they launched the concepts of "prototyping" and "protostorming". At prototype seminars the students present their work and get feedback from teachers, industrial clients and peers.

The authors used Larry Leifers metaphor, "Hunting party in unchartered terrain," to explain the iterative nature of the work they expected the students to perform: "Search one area – Return to camp and report – Go out again based on the discussion in camp: Non linear problem formulation; Jump between "theory" and "empirical findings".[Leifer 2010] In fact. Larry Leifers methodology is very close to the authors interpretation of Problem Based Learning.

The authors aimed at creating a context where collective effort and cooperation were the most effective ways to complete the assignment given. They stressed that on this particular "hunting trip" you should never go alone, work hard to preserve ambiguity and that all design is re-design (Larry´s three rules).

The prototyping seminars were aimed at strengthening the incentive for peer-peer learning by focusing on tangible communication (show and talk) – although the product was a written paper/report and an oral presentation. By prototyping and "protostorming", and with a focus on unfinished presentations of ideas and prototypes, the authors wanted to create a creative atmosphere. In total, they had four mandatory prototype seminars (cross section) and reoccurring coach seminars (scheduled and on demand).

Before the first prototype seminar, the three companies had given a lecture on their respective businesses and presented a general problem formulation. Each team got the task to formulate their preliminary *problem formulation,* a preliminary *general research question* and a preliminary *objective*. This was called "Prototype 1" and presented orally and as a Powerpoint presentation at the first prototype seminar.

Before the second prototype seminar, the three teams from each company (A1-3, etc.) visited the company and presented their respective prototype 1 to get feedback and comments. After this meeting, each team was asked to restate a new version of their *problem formulation*, *general research question* and *objective* ("Prototype 2"). Prototype 2 also included a discussion on delimitations, a discussion on primary and secondary sources, a discussion on possible bench mark studies that could be of interest and a description of the project plan and project organization for each team. Prototype 2 was presented orally and as a Powerpoint presentation at the second prototype seminar.

Prototype seminar three, the midterm seminar, included all stakeholders in the course, i.e. course management, the company coaches and the company representatives. The task was to present and discuss the project work and results half way in the process by a full "mock up" report.

Prototype seminar four was the last prototype before the finalization of the report and the oral presentation. This fourth prototype was to be a preliminary version of the report based on the standard academic form and a preliminary version of the final oral presentation. On this fourth seminar, the students were supposed to discuss the parts that were missing in the final report. Prototype 4 was presented orally and as a Powerpoint presentation at the fourth prototype seminar.

The last seminar was not really a prototype seminar. By now the students presented their final product in full class. The company representatives were invited and gave comments on the presentations. This was actually the first time the three student teams working for the same company were able to get to know the work of their fellow consultants.

To conclude, it is safe to say that the authors managed to maximize the feeling of authenticity in this project course by using prototyping as a tool. The students had to interact with their clients in a continuous loop from the first feedback meeting with the company and formulating the first prototype problem formulation, over the mid-term seminar and all the way to the presentation of the final product.

The authors aimed at creating a context where collective effort and cooperation was the most effective way to complete the assignment given. The prototyping seminars gave incentives for peer-peer learning by focusing on tangible communication (show and talk). By prototyping and "protostorming", and with a focus on unfinished presentations of ideas and prototypes during the course, the authors managed to create a creative atmosphere. The students did not fear change, ambiguity or unclear and vague instructions.

Academic Paper and Consultancy Report

Returning to the authors claim that the academic paper is the "mother of all papers," they postulated that in all consultancy deliveries – in whatever form it may be – the structure and the logic of the academic report are of fundamental importance and vital to ensure quality, reliability and validity in any situation. The authors argue that IM students must understand that mastering academic methodology and writing is bringing added value to the client. The final product was defined as:

- A written report in the form of an academic paper.
- A Powerpoint presentation based on the most important results, presented orally in front of each company
- An executive summary based on the academic paper.

For the academic paper the authors stressed the importance of investigating the case from the IM-systems perspective (individual, functional, industrial). The authors used the general template for an academic paper, already utilized in the first course (PIM), they stressed the importance of both primary and secondary sources, and the need for a clear message/thesis. The template used was the standard form: Introduction – Dissertation – Conclusion:

Introduction: Present the general problem formulation (or background – why is this interesting and not a trivial problem?). Present the general research question. Give the objective/purpose of the investigation and the main concrete questions to be answered. Also discuss your delimitations. Describe your theoretical concepts, your method and discuss your sources critically (source criticism).

Dissertation: The results are presented, i.e. the questions are answered and discussed in relation to your theoretical concepts and in relation to results in previous research. The disposition of this part of the paper is highly dependent on the objective, the questions, the time span of the investigation, etc.

Conclusion: The main results are to be summarized and discussed critically – are the results accurate, is it possible to draw general conclusions, etc.? Give advice to your costumer; present your thesis. Also include a discussion of managerial implications following from the recommendations you put

forward. Remember to include implications from all the three IM-perspectives. Note that this is a good opportunity for you to identify future research questions inspired by your investigation – i.e. you are to convince the company that your results can lead to interesting master thesis projects and further need of your services as consultants.

The authors demands on the academic report: accuracy, validity and reliability, were very high. They wanted the students to realize the importance of quality when delivering advice to a client. Perhaps the client won't actually read the full report. But the facts, the evidence and the arguments to underpin all solutions are stored in the report. The academic methodology is the best insurance a consultant can get.

For the Powerpoint and the oral presentation in front of the class, course management and, not the least, the industrial clients, the authors used a rhetoric template introduced in the earlier course mentioned above (ITTEC). The template is based on a classic formula of argumentative speech: Introduction: Create ethos – win the audience. Introduce your thesis; Argumentation: Use logos. Support the thesis–three arguments; Conclusion: Summary of thesis and the three arguments. End with pathos. (Aristotle, 4th century BC). The authors wanted students to be able to boil down the three most important results of their investigation and present them in front of an audience in a twenty minutes speech.

The third part of the final product was a five-page executive summary of the report (typically 40-60 pages) and the Powerpoint, handed in to the company representatives for circulation among colleagues at the home base.

Authenticity concerning the final product and deliverance of results were very high. The industrial clients participated at the final seminar and discussed pros and cons of the results presented by all three consultancy teams working for their company. The discussions in the seminar on the validity of different, and contradicting, advice from different teams, were heated. Everyone wanted to argue for their own solution to the problem perceived. For the company representatives, it became obvious that one given problem area could generate many answers. They agreed on the obvious benefit of getting their problem highlighted from several angels and on the benefits of getting clearly stated results possible to implement in business. They also appreciated (perhaps a bit surprisingly) the thorough academic connection to theory: "This is great! Typically we don't have time to go this deep into a subject in our day- to-day business". The students learned to appreciate the difference between a written report and a speech. But more importantly, they learned "saw and felt" the ambiguity and complexity of authentic organizational *change*.

Examination Portfolio

Authentic live-cases, group-based work and advanced skills training, demand non-traditional examination tools. Standardized written examination is hardly possible to implement in order to assess skills and learning from real world complexity – which the authors value as the most important learning outcomes in the later stages of the master program. Especially when it comes to group-based projects, central activities for how to train core skills and capabilities, assessment is demanding. A founding pillar in strong educational environments is the individual assessment of core learning outcomes – without this one can never guarantee the quality of an educational institution. Therefore, the authors must adapt to effective tools for individual assessments of knowledge and skills also when educational activities are based on large group project work.

The approach used in the CPIM course builds on the early introduction and acceptation of examination portfolio in the program (reversed burden of proof). The authors have used: 1) Individual argumentation in the "learning paper" for each learning objective; 2) Individual literature review (related to case); 3) Individual reflection of group's work, progression, and achievements; 4) Signed peer-student feedback, rating and confirmation of #1. Together with the group's final report and presentations, this represents the examination portfolio in the CPIM course.

The authors argue that this type of examination allows them to combine students work with authentic cases and at the same time support individual examination; it is also in itself an authentic type of assessment. That is to say, this examination tool is very similar to professional assessment methods used in industry. For example, in performance management – as used by most companies and extensively described in the HRM literature (e.g. Bohlander and Snell 2010) – performance assessment is partly based on the employee's own arguments of how they have reached the goals during a certain time period.

CONCLUSION

In this paper the authors have discussed their application and development of case methodology in the IM Master Program at the department of Industrial Economics and Management at Royal Institute of Technology, Stockholm. The authors stated that Bachelor students can handle large workloads, are analytically skilled and trained in problem solving but also that industrial managers do not primarily solve problems, they formulate problems. Thus, their goal is to enhance the students' transition from problem solving to problem formulation. The authors have used case-based learning to facilitate this transition.

They argue for a progression beyond pre-developed cases. Traditional case methodology is not enough to reach the learning objectives of a master program in Industrial management. Authentic live cases are a necessity when trying to turn problem solvers into problem formulators, when learning to love ambiguity.

Two important objectives guide the IM master's program: Firstly to prepare students for future managerial positions in technology intensive industrial organizations and secondly for the possibility of future doctoral studies.

A synthesis guiding the IM-program and especially the design of the last course (CPIM) is presented:

> An authentic industry case run like a consultancy project through prototyping seminars resulting in a consultancy report/presentation based on an academic paper and examined by a portfolio model.

Building the learning activities around authentic challenges within the partnering companies was the strongest aspect of authenticity in CIPM. Few alternatives can offer similar opportunities for students to experience e.g. the characteristics of "see – feel – change," related to change management. However, authenticity is only part of the learning objectives of the course. In order to incorporate these activities along with fundamental requirements in higher education, such as to critically evaluate theory and individual assessment, many parts of the teaching toolbox (i.e. PBL) and curriculum must be reconsidered (i.e. constructive alignment).

Having a visible and real receiver of the students' work was another important factor of authenticity. Apart from grades motivating the students they had a possible future employer playing a part in the setup. Hence, the group dynamic was considerably leveraged by the introduction of an industrial partner. This design generates very important activities for training of professional skills any master program.

However, there are also risks associated with these types of course designs. Firstly, a lot of responsibilities is put in the hands of students. In more traditional courses, students can often choose more freely how they participate (e.g. in lectures) and then be assessed by more traditional tools (and having the opportunity to conduct re-examination) Here these aspects must be addressed differently due to the reduced possibilities to repeat certain activities. The second risk is in communication between course management and the companies. It is of great importance that both parts have the same understanding of the project to avoid contradictory instructions to students. Ambiguity must be intended, not a result of mistakes.

The authors also managed to maximize the feeling of authenticity in this course by using prototyping as a tool. The students had to interact with their clients in a continuous loop from the first feedback meeting with the company and formulating the first prototype problem formulation, over the mid-term seminar and all the way to the presentation of the final product.

The authors succeeded in creating a context where collective effort and cooperation was the most effective way to complete the assignment given. The prototyping seminars gave incentives for peer-peer learning by focusing on tangible communication (show and talk). By prototyping and "protostorming", and with a focus on unfinished presentations of ideas and prototypes during the course, the authors managed to create a creative atmosphere. The students did not fear change, ambiguity or unclear and vague instructions.

Authenticity concerning the final product and deliverance of results were very high. The industrial clients participated at the final seminar and discussed pros and cons of the results presented by all three consultancy teams working for their company. The discussions in the seminar on the validity of different, and contradicting, advice from different teams, were heated. For the company representatives it became obvious that one given problem area could generate many answers. They agreed on the obvious benefit of getting their problem highlighted from several angels. The students learned to appreciate the difference

between a written report and a speech. But more importantly, they learned “saw and felt” the ambiguity and complexity of authentic organizational *change*.

Authentic live-cases, group-based work and advanced skills training, demands non-traditional examination tools. Especially when it comes to group-based projects, central activities for how to train core skills and capabilities, assessment is demanding. The approach used in the CPIM course builds on the early introduction and acceptation of examination portfolio in the program (reversed burden of proof). Together with the group’s final report and presentations, this represents the examination portfolio in the CPIM course.

Not only does this type of examination allows students to work with authentic cases and at the same time support individual examination; it is also in itself an authentic type of assessment. That is to say, this examination tool is very similar to professional assessment methods used in industry.

Two quotes from the evaluation of CPIM summarize the benefits of authentic live cases:

> “[the best thing was] The prototyping concept with feedback, which allows the group to constantly work with the final product. In the case where you only get feedback in the end of the course it's easy to forget about it. Recurring feedback and meetings with the team coach has also been great--reality-based cases, that’s really good!”

> “One main strength, believe it or not, has been the ambiguity of the case. It really feels as if we did not get much help from anybody - but this is good! I can really picture that is how it is in real working life, people are not always gonna have your back and you have to make the most of the little information you have in a complex environment. It really feels as if this course has made me less afraid of vaguely formulated problems in a serious and "sharp" context, and actually being able to deliver something after all makes me have a confidence boost and feel some pride.”

REFERENCES

Aristotle: *Treatise on Rhetoric*, 4th century BC.

Barrows, H. S., & Tamblyn, R. H. (1980). *Problem-based learning: An approach to medical education*. New York, NY: Springer Publishing.

Bengtsson, L. & Asplund, C-J. (2008). Case writing projects in co-operation with companies and organizations. *International Journal of Case Method Research & Application*. XX, 4.

Bengtsson, L. and Asplund, C-J, (2007). *Using case writing in strategic management education*. Paper presented at the educational sessions at NFF Conference in Bergen, Norway, 9-11 August 2007

Biggs, J.B. & Collis, K.F. (1982). *Evaluating the Quality of Learning*: The SOLO taxonomy. New York: Academic Press.

Biggs, J.B. & Tang, C. (2007). *Teaching for Quality Learning at University*, Third Edition. Berkshire: McGraw-Hill.

Black, P. and Wiliam, D. (1998). Assessment and classroom learning, *Assessment in Education: Principles , Policies & Practice*, (5):5-74.

Bohlander, G.W. and Snell, S.A. (2010). Principles of Human Resource Management, 16th ed. London: Cengage Learning EMEA

Cheong, France, “Using a Problem-Based Learning Approach to Teach an Intelligent Systems Course” in *Journal of Information Technology Education* Volume 7, 2008, Editor: Linda Knight.

Christensen, C.R., & Hansen, A.J. (1987). *Teaching and the case method*. Boston: Harvard Business School Press.

Datar, S.M., Garvin, D.A., & Cullen, P. (2010). *Rethinking the MBA: Business Education at a Crossroads*. Boston: Harvard Business Press.

Dunkin, M. & Precian, R. (1992). Award-winning university teachers' concepts of teaching. *Higher Education*, 24: 483-502.

Edström Kristina , Sigbritt Karlsson, Eva Malmström Jonsson and Mats Hanson Royal Institute of Technology (KTH), Stockholm, Sweden: *A STRATEGY FOR IMPLEMENTING CDIO ACROSS AN INSTITUTION* Proceedings of the 5th International CDIO Conference, Singapore Polytechnic, Singapore, June 7 - 10, 2009.

Edström, Kristina & Jakob Kuttenkeuler "Från student till ingenjör – om program- och kursdesign med CDIO", Presentation given at INDEK, 17 maj, 2010.

Hallström S., Kuttenkeuler J., Edström. K., "The Route Towards a Sustainable Design-Implement Course", Proceedings of 3rd CDIO Conference, Cambridge, MA, USA, 2007.

HBS MBA (2012). http://www.hbs.edu/mba/academics/casemethod.html

Honeycutt Sigler, T. (2006). "Live case studies in organizational change: Learning about change through student philanthropy and service-learning". *International Journal of Case Method Research & Application*, XVIII, 2.

Kotter, J.P. and Schlesinger, L.A. (2008). Choosing Strategies for Change. Harvard Business Review. July-August: 1-11.

Kotter, J.P., and D.S. Cohen, The Heart of Change: Real-Life Stories of How People Change Their Organizations (Harvard Business School Press, 2003).

Marseth, K.K. (1996). Cases and Case Methods in Teacher Education. In John Sikula (ed.) *Handbook of Research on Teacher Education*, 2nd ed. New York: Macmillan, pp. 722-744.

Mazur, E. (1998). *Peer Instructions: A User's Manual*. Englewood Cliffs, NJ: Prentice-Hall.

Presentation given by Larry Leifer at the PIEp Workshop: *Changing Mindset, Improving Creativity and Innovation in Engineering Education*, Stanford University, December 13-17 2010.

Spence, Larry D. "Problem Based Learning: Lead to Learn, Learn to Lead." (Director, Undergraduate Learning Initiatives, School of Information Sciences and Technology, Penn State University, USA. http://www.studygs.net/pblhandbook.pdf (accessed 2012-02-24).