Opening the Black Box of Collaborative Writing: Experiences from a Teamwork Based Course in Industrial Management

Lars Uppvall[1], Pär Blomkvist[1], William Bergqvist[1]

[1] Department of Industrial Economics and Management, Royal Institute of Technology, Stockholm, Sweden

Email: par.blomkvist@indek.kth.se, lars.uppvall@indek.kth.se, wber@kth.se

Abstract

In this paper we discuss the introduction of Collaborative Writing (CW) tools in a course in the Industrial Management master program at the Royal Institute of Technology (KTH), Stockholm. The course, and the whole program, is designed using learning activities based on Problem Based Learning (PBL), Authentic Case Methodology and Teamwork.

Our students have the general knowledge how to lead, plan and execute a teamwork based project. But what about writing? What happens if a large part of a project is actually to write a collective report?

We argue that CW is a vital, but poorly understood, part of teamwork, that CW is a black-boxed activity. Nearly every teamwork project includes CW. But no one really pays much attention to what we actually do, when we produce a text in a team setting. Our ambition is to open the black box of CW and discuss how CW-concepts can enrich teamwork activities.

The paper builds on our students' reflections on challenges linked to CW in a teamwork setting. As part of the course examination the students were asked to evaluate the usability of CW-tools in performing the teamwork project. In total the data consisted of 77 individual reflection papers with a length of min 2 and max 3 pages, which were analyzed using constructs from prior literature on CW.

Our results show our students actively used CW tools and strategies and that CW had a large impact, and in fact enhanced teamwork management. The CW-tools also helped in creating sustainable teamwork in the sense that they enhanced the three criterions of team performance: *productivity*, *cohesion*, and *learning*.

Keywords: Active learning; Engineering education; Collaborative writing; Teamwork.

1 Active Learning in the IM-master program

In this paper we discuss the introduction of CW-tools in a course in the Industrial Management master program at the Royal Institute of Technology (KTH), Stockholm. By CW-tools we mean concepts and methods that highlights the collective writing process (see chapter 3). The course, where CW was introduced, and the whole program, is designed using learning activities from what we call our *active learning package*. This package consists of three elements: Problem Based Learning (PBL), Authentic Case Methodology and Teamwork.

PBL is our pedagogical foundation, Authentic Case Methodology is our way of implementing PBL, and Teamwork is naturally an integrated part in both PBL and case methodology, and, for obvious reasons, a central part in management education. Teamwork knowledge is usually framed by concepts from the fields of Project management and Team leadership. Our students have the general knowledge how to lead, plan and execute a teamwork based project. But what about writing? What happens if a large part of a project is actually to write a collective report?

We argue that CW is a vital, but poorly understood, part of Teamwork, that CW is a black-boxed activity. Nearly every teamwork project includes CW. But no one

really pays much attention to what we actually do, when we produce a text in a team setting.

In this article we present the results of an investigation on the implementation of CW-tools as an extension of our *active learning package*. We want to open the black box of CW and discuss how CW-concepts can enrich teamwork activities. We argue that CW in fact facilitates and enhances the quality of Teamwork, by making a large portion of the work explicit and possible to reflect on.

The Industrial management two-year master program (launched in 2010) admits 70-100 engineering Bachelor degree students per year (e.g. Mechanical Engineering, Computer Science, Material Design). Students come from BSc programs at KTH and through an international admission. In this paper we focus on one specific course where Active Learning is especially prominent. The course is called *Change Project in Industrial Management* (CPIM). We discuss the introduction of CW-tools in the CPIM course and how these tools have influenced Teamwork in the case assignment given to our students.

Subject vise 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, functional, strategic and the industrial dynamic perspectives. Our students' has the ability to handle large workloads, they are analytically skilled and trained in problem *solving*. At the same time industrial managers do not primarily solve problems, they *formulate* problems. Our goal is to enhance the students' transition from problem solving to problem formulation. To foster this transition, we have as mentioned, introduced an *active learning package* including **PBL, Authentic Case Methodology and Teamwork** and before we explain the role of CW-tools in the CPIM course we will briefly present these central learning activities:

<u>PBL</u> is a well-known concept (Cheong 2008, Spence 2012, Barrows and Tamblyn 1980). Learning comes from the students struggle to absorb, understand, reformulate and solve a complex real world problem setting. In PBL the focus is put on vaguely defined problem scenarios and students are expected to engage in the complex situation presented and decide on their own problem formulation. (Cheong, 2008; Spence 2012) The bottom line in our version of PBL is aligned with our goal of turning *problem solvers* into *problem formulators*. We insist on presenting the students with vaguely structured problems and open ended questions — Why? Because ill structured problems prepare you for a managerial position.

Our second active learning activity is **<u>Authentic Case Methodology</u>**. By using authentic cases we contend that there is a need for a progression beyond pre-developed cases. Traditional case methodology is not enough to reach our learning objectives. We argue that authentic cases are a necessity when trying to turn problem solvers into problem formulators and that learning activities must encompass elements that bring a high degree of *ambiguity* to the problem setting.

The Authentic Case Methodology is introduced early in the program and executed fully in CPIM, where we engage four industrial companies as partners. All companies represent large industrial companies (Net sales >2 700 €), all are global or Pan-Nordic, and all have a strong demand of Industrial management competence.

The practical setup is quite complex. We label the four companies A, B, C and D and each company is assigned three student teams (6-8 students each). Thus we have a total number of 12 groups (A1-3, B1-B3, etc.) investigating change processes in four industrial areas. Each team gets 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 an academic report."*

Each team presents the whole scope of the project for the company representatives three times (problem formulation; mid-project reporting; final product). During the project students visit the company several times. Planning, setting up meetings, interviews and other types of data collection are important parts of the skills training.

Our third active learning activity is **Teamwork**. As touched upon earlier, our students have quite a lot of knowledge from courses in for example Project Management. In the CPIM they are challenged with an assignment where the final product is a large academic report (approx. 60 pages) written collaboratively. Building on their general teamwork experience, we explicitly add writing into the repertoire of teamwork skills.

Our approach to writing has, since we launched the master program, been connected to the notion of "tangible communication". We argue that in an Industrial master program, you are supposed to actually build a product. And in this case the written report is the product.

Inspired by Design Thinking at Stanford University (Leifer 2010; Carleton et. al. 2013) we have launched the concepts of *prototyping* and *protostorming*. At prototyping seminars, the students present their drafts and get feedback from teachers, industrial clients and peers. The seminars are aimed at strengthening the incentive 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, we believe that we have created an atmosphere where both teamwork processes and the writing process are in focus.

By implementing PBL, Authentic Cases Methodology, and Teamwork, we have set the stage and created structures for Active Learning in a project bases course, where the students formulate and solve a real world change project. In the CPIM course we have already put the written report at center stage of the teamwork process (prototyping a product). In the following we concentrate on the addition of CW-tools into this teamwork setting and how these tools have enhanced the Teamwork. For further details on program design and authentic cases of our master program see Blomkvist and Uppvall (2012 a,b).

2 Purpose, Research Questions and Method

Our purpose is to investigate the effects of CW on the teamwork in a project based course where collective text production is a central part. Our research questions are:

1. Did the students use the CW-tools and how did they use them?

2. How did CW influence teamwork activities (including management of teamwork)?

3. Did the introduction of CW-tools help to create sustainable teamwork?

The paper builds on the CPIM-students' own reflections on challenges linked to CW in a teamwork setting. As a part of the course examination we asked the students to write an individual paper evaluating the usability of CW-tools in performing the group project. We gave them the following assignment:

Provide a short individual report covering insights and challenges related to the process of Collaborative Writing (CW). Can concepts of from the field of CW help in creating sustainability on an individual/group level when working in these types of projects (similar to the CPIM course)?

As a foundation and to create a common nomenclature we gave a lecture on CW-tools and distributed the following two articles explaining and discussing CW:

– Building a Taxonomy and Nomenclature of Collaborative Writing to Improve Interdisciplinary Research and Practice, by Lowry et al. (2004).

– Collaborative writing in engineering: Perspectives from research and implications for undergraduate education, by Gimenez and Thondhlana (2012).

In total the data material consisted of 77 individual reflection papers with a length of min 2 and max 3 pages. The material was analyzed in **two stages** according to students' own use of CW tools in their projects. First, the material was coded using constructs from prior literature on CW. Themes and codes for CW strategies and Document control was based on the constructs presented by Lowry et al. (2004). The analysis of CW writing activities used themes from the work of Gimenez and Thondhlana (2012). In the second stage we adopted a more open approach using both the complete material and the reduced, coded, material interpreting the students accounts on the relation between use of CW tools and teamwork management as well as teamwork dynamics.

3 The students' use of CW-tools

In this part we will present and shortly discuss our results regarding our first research question: Did the students use CW-tools and how where these tools used? These results will mainly be presented in a quantitative format, following taxonomy by Lowry et al. (2004).

Starting with the use of CW strategies, the summarized results are presented in Table 1, below.

Strategy (Lowry et al. 2004)					
Strategy	Singel author writing		Parallel writing		Reactive writing
	Group single author	Sequential	Horizontal division	Stratified division	
Sum (tot no = 77)	15	15	63	33	35
%	19%	19%	82%	43%	45%

The most frequently applied CW strategy is Parallel writing/Horizontal division writing, described as applied by 82% of the students. This means that this CW strategy is almost twice as frequently applied as the two next frequently used CW strategies: Reactive writing (45%) and Parallel writing/Stratified division writing (43%). Single author writing CW strategy were in total applied by 38%, with an even distribution between Group single author writing (19%) and Sequential writing (19%).

These results confirm that the students used CW-tools actively and to a high degree in order to manage their writing activities in the course. All students, except from 4, were able to identify and clearly describe how different types of CW strategies were used in relation to their group's collaborative writing process.

When it comes to which of the CW strategies that the students used throughout the projects, the high proportion of Parallel writing/Horizontal division writing could be expected. This particular strategy is described as effective for high volume and fast input (Lowry et al., 2004). Hence, given that large student groups, heavy workload, and an expected high volume output characterize the course in focus, the Parallel writing/Horizontal division writing strategy could be argued to be the most logical choice. All groups used a parallel strategy in at least some stage of their writing process in order to cope with the size of the given assignment.

Furthermore, these results also confirm the results by Gimenez and Thondhlana (2012) regarding the dynamic aspects of CW applied in students group work. However, our analysis seems to show a more emphasized process logic. That is, while the results of Gimenez and Thondhlana (2012) mainly connects CW strategies to the writing of different parts of a report, our results seem to reflect more managerial aspects of handling a process. More specifically, going from problem formulation (creative) toward the handling of different authors contribution and assuring the logic of the report's reasoning and quality aspects when meeting a deadline (complexity).

4 The role of CW in Teamwork

In this part of the paper we turn to the second research question: How did CW influence teamwork activities (including management of teamwork)

As we showed above, CW was used actively and issues how to manage the CW-tools were prominent in the student´s reflections. In the following we move to a qualitative analysis focusing on these managerial aspects. We use well known concepts from management and teamwork literature (*in italics*), when analyzing our student´s reflections (the same concepts are present in the course literature from earlier courses in Project management and Team leadership: e.g. Thompson, 2011; Maylor, 2010).

In all teamwork, as our students are well aware, *planning* is a key component. In our source material we can see strong agreement on importance of planning and planning and re-planning. There is a clear link between shifts in project structure and shifts in CW strategies.

As expected a large part of the planning activities were about *setting objectives* for the project. Since the written report is the outcome of these projects (as typical for most management consultant work) many of the project objectives were set in the context of writing. A large part of the groups "internal objectives" was focused on the text in itself, text structure and text quality. Students used their knowledge on effective teams and transformed them into CW strategies.

In early parts of a project students typically struggle with *breaking down* the overall project objectives in to sub-tasks. This aspect had a huge impact on CW activates in the course. How students simultaneously worked with defining the industrial problem, learned from theory related to the problem, and wrote texts to share new knowledge is described in our data as a highly complex managerial challenge. Examples of such situations are individual student's different ability to accept uncertainty, different ability among sub-groups to develop strong group dynamics, and issues of acceptance regarding the fact that some of the work done will not be useful as a mean for the projects' outcomes, and had to be scraped, are all interesting and complex aspects of both Teamwork and CW.

Deciding on different *roles* in the teams, including appointing a *leader*, represents central aspects in team-leadership literature, but is also frequently highlighted in resent CW research. Students often referred to these aspects as critical when discussing difficulties or as a part of overcoming obstacles related to coordination and complexity in their projects.

In addition, several groups also deliberately changed their leadership according what challenged different phases of the project put on the team, either by replacing the person holding the leader position or by adopting a different leadership style. Students referred to different writing activities (such as drafting, producing literature overviews and final editing) and how they related to a perceived need of leadership. Most clear were the abilities to socially engage all members during problem formulation and drafting (including objectives), the need for interpersonal relations and motivation from the leader with overview and individual students when complexity of the text grew.

Project organization and structure was also influenced by the CW-tools. Students used CW strategies in order to meet critical aspects within their projects. The results also show that most students had actually worked in similar patterns as described in CW literature (Lowry et al. 2004) in earlier projects of this type in order to meet aspects, such as of high volume of text output and limited ability to physically write together. However, having a common nomenclature on CW seems to increase the teamwork management activity. Having a toolbox of structures directly aiming for the type of work students actually do in most assignments – namely to wright collaboratively – enhance students' abilities to actively use knowledge and skills obtained in e.g. prior project management courses, as reflected upon in the quote below:

"CW is something that has been commonly used throughout my academic education, however, this is actually the first time I have reflected over it. I believe that it is very important to reflect and analyse your working methods, both what can be improved and what have been performed perfectly, in order to improve your abilities. Therefore, I believe that this exercise is important and it is also quite strange that I never got it before."

IT-tools are an integral part in all teamwork management. It is obvious that software and IT-tools is of great importance in collaborative writing practices. In the literature the focus is mainly set on advances and positive outcomes from (e.g. Zhou et. al., 2012). When our students reflect on theses aspects from a team management perspective, the outcome of IT-tools is less clear. Some examples were given students struggle to find IT-tools that offered sufficient richness in communication. This often led to less use of IT tools since the one of its main benefits (to work asynchronous) did not work in practice.

However, there are also many positive examples from teams that actively used IT-tools in their collaborative writing. It seems as the most common benefit was the use of IT-tools for final editing and adjustments for cohesion. Interestingly, this was sometimes described as a face-to-face approach where each author had its own computer. By this, teams could overcome both challenges associated with authorize a single author to make the final adjustments and restrictions in communication using these IT-tools when physically separated.

Lastly we would like to touch upon an issue that every team has to manage: *quality assurance*.

We want to highlight that a high proportion of students emphasized the use of CW-tools for reaching expected quality of their final texts. Our results indicate, that the simple fact that students got access to models and nomenclature regarding CW is reported to enhance both the process and outcome of their texts. These CW-tools, in a basic manner, seemed to help students to plan, keeping track of, and evaluating links between how they managed the team and the progression of the quality in their reports. In the quote below these aspects are discussed:

"Besides realizing the challenges and difficulties that can occur when six people are trying to write a report together there were also hidden benefits. What we realized in the CPIM course was that when writing together we could identify gaps and flaws in our solution. This helped us elaborate more on our analysis and as a result we were able to refine our initial solutions. Furthermore the collaborative writing helped us truly understand the analysis and the solution, something that is validated by the literature as well (Gimenez and Thondhlana, 2012)."

5 Sustainable Teamwork

So far we have established that our students actively used CW tools and strategies and that CW had a large impact, and in fact enhanced teamwork management. In this section we turn to the inner workings of the team – teamwork

dynamics – and discuss its relation to CW. We address the third research question of this paper: Did the introduction of CW-tools help to create sustainable teamwork?

In line with prior CW literature, high-performing groups conducting CW must be able to simultaneously organize the CW-work effectively and develop the group's dynamic processes. The overall aim is to reach sustainable teamwork. That is, teamwork that leads to sustainable performance of the group during and after the project.

Sustainability in team performance could be evaluated based on three aspects according to Thompson (2011). These are *productivity*, *cohesion*, and *learning*.

In order to achieve high *productivity* it is argued that teams must be able to adapt, change, and adjust project goals. One of the fundamental characteristics of the CPIM-course is the ambiguity inherent in the assignments given to the students. This means that no team will be able to reach a high level of performance without actively managing change and adoption. Therefore teams also need to develop capabilities of handling change and adopt in order to meet the objectives of the project and to reach sustainable performance.

For most teams using the CW-tools and knowledge seemed important in order to facilitate change, as illustrated in the quote below:

 "Our project benefitted from adjusting CW strategy based on how much joint decision and convergence was needed based on what section was written and in what phase we were in. Shifting control mode and roles brought issues such as lack of consensus, differences in style and lack of familiarity to information up to the surface, stimulating an iterative process of CW activities where drafting and reviewing in led to brainstorming and convergence on brainstorming, that in turn led to revising and editing."

Change in complex projects is also dependent on *cohesion* among its members in the team. Most teams articulated a strong need for face-to-face meetings in order to facilitate communication. Successful work was often reported as a result of frequent and long meetings with the whole group gathered. But we can also find reflections where some members at the time questioned the usefulness of these meetings, only to realizes its value later in the project. This need for a common view (*cohesion*) of the project by all team members is illustrated in the quote below:

"The group needed to come to a consensus on how to delimit the study to make it feasible to conduct in the short period of time available. This was in fact one of the main issues throughout the project, i.e. to ensure that all group members had the same idea of the tasks that needed to be done and that they were done in a coherent manner"

However, when communication fail and cohesion gets weak, there is only a matter of time before mistakes are made, such as overlapping work when group members are unaware of what other are doing. In these situation the articulated knowledge of different CW strategies – the acquired nomenclature – is reported to be important. Teams use this knowledge in order to agree on structural changed to overcome these types of issues and to achieve higher effectiveness in their work.

Turning to *learning*, the third aspect of team performance, we can conclude that our students' use of CW knowledge lead to good performance through an ability to *learn from work and develop* their working mode. Firstly, a strong focus on communication was present in most teams. The urge to reach higher level of richness in communication was also a common aspect leading teams to experiment and develop hybrid CW strategies. Typical examples were teams that managed writing in peers, or trios, when using overall parallel strategy. Secondly, using CW-tools is described as making members more involved in all parts of the projects and is perceived as positive for team member´s commitment to the

project – thus creating trust. Since trust is built on the perceived fulfillment of expectations from another person, this aspect of CW in the teams was highly valuable. The aspect of trustful relationships is also often described as proof of team performance and strength of teams. Especially, since division of tasks seldom results in an even distribution of workload all the time, members need trust in order to manage a "give and take" balance over time.

However, it should also be mentioned that teams not always succeeded in terms of workload distribution. From a CW perspective editing work in the final stages often lead to situations where members with high capacity in this area were experiencing putting in more effort than others.

Finally, there were also some concrete examples of increased transparency coming from the use of CW-tools that helped teams manage typical aspects of student teamwork. One such aspect was related to social loafing or free-riders, as shown in the quote below:

"I would argue that the CW method used was the major factor influencing our team work, so that we could avoid social loafing. The CW method we used ensured that everybody had a specific task to accomplish, and no one could free ride on this project."

6 Conclusion: CW as a Tool for Active Learning

As discussed above, students in the CPIM course used CW tools extensively. The introduction of CW opened up the black box of writing activities in students' projects. For example, it facilitated students' ability to express writing related issues and helped students to identify need and directions of change in their collaborative writing setups. As such, CW contributed positively to our active learning package by making a large part of the teamwork explicit and possible to reflect on.

The CW-tools also helped in creating sustainable teamwork in the sense that they enhanced the three criterions of team performance: *productivity*, *cohesion*, and *learning*.

Finally, we would like to touch upon another meaning of the term sustainable teamwork. That is, teamwork skills and methods that are explicit and possible to reproduce. Sustainable in this sense would mean that the CW-tools also can influence future teamwork and the acquired CW knowledge can be transferred to other settings.

Of obvious reasons we don´t have any data on how CW will influence our student´s future teamwork assignments. But a strong indication that CW in fact has influenced student views on teamwork is given by frequent witnesses on the eye opening quality of CW. Before getting the CW-knowledge they struggled with low team performance due to non-existent structure related to CW. Many student´s express frustration on why they had not been introduced to CW earlier in their education. Based on these testimonies we argue that the introduction of CW-tools most probably will increase team performance in the long-term.

We hope, that by introducing CW-tools we have given our students a deeper knowledge regarding teamwork. That is, by making CW explicit as a teamwork activity and possible to reproduce, we believe that we have enhanced their abilities to continuously learn and perform in future educational and professional writing centered teamwork (Lowry et al., 2004; Gimenez and Thondhlana, 2012; Biggs and Tang, 2007)

7 References

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

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

Blomkvist and Uppvall (2012 a) Blomkvist, Pär and Lars Uppvall: "A Chain is only as Strong as its Weakest Link: Managing Change in the Curriculum of Industrial Management Education" in *International Journal of Industrial Engineering and Management* (IJIEM), Vol. 3 No 2, 2012, pp. 53–65

Blomkvist and Uppvall (2012 b) Blomkvist, Pär and Lars Uppvall: "LEARNING TO LOVE AMBIGUITY: AUTHENTIC LIVE CASE METHODOLOGY IN INDUSTRIAL MANAGEMENT EDUCATION" in *International Journal of Case Method Research & Application* 2012, XXIV, 4

Carleton, T., Cockayne, W. & Tavahainen, A. (2013). *Playbook for strategic foresight & innovation.* Available at: http://foresight.stanford.edu:16080/playbook/.

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

Gimenez, J., & Thondhlana, J. (2012). Collaborative writing in engineering: Perspectives from research and implications for undergraduate education. *European Journal of Engineering Education*, *37*(5), 471–487.

Larry Leifer at the PIEp Workshop: *Changing Mindset, Improving Creativity and Innovation in Engineering Education*, Stanford University, 2010

Lowry, P. B., Curtis, A., & Lowry, M. R. (2004). Building a taxonomy and nomenclature of collaborative writing to improve interdisciplinary research and practice. *Journal of Business Communication*, *41*(1), 66–99.

Maylor, H. (2010). Project Management 4:ed. Essex: Pearson Education.

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).

Thompson, L (2002) *Making the Team. A Guide for Managers*. International Edition. Pearson.