GETTING THE MOST OUT OF A COLLABORATIVE RESEARCH PROJECT: CROSS INDUSTRY DESIGN FOR A HOLISTIC VIEW AND INCREASED LEARNING

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Lately, collaborative research has gained recognition. The balance between scientific rigour and practical relevance is a continuing issue within construction management research. The purpose of this paper it to describe a cross-industry and cross disciplinary approach to co-creation of knowledge through a collaborative research approach. A collaborative research project on the topic communication regarding customer specific demands is presented using a model with two interacting cycles for knowledge creation. Two construction companies, a housing company with off-site manufacturing and a small subcontractor manufacturing street doors and front doors, are participating. Four other companies within mechanical manufacture, telecom and consultancy are involved. To engage the companies, the project emphasizes activities not adding any contribution to academic production. Networking, industrial education, publications in trade journals, participation in trade fairs etc. might be essential to convince the industry of the practical relevance. The findings prove that applied research does not need to be isolated to specific industries or disciplines, as the collected data are applicable to the different participating companies' despite of their differences.

Keywords: collaborative research, communication, cross-industry, cross-disciplinary

INTRODUCTION

Lately, collaborative research has gained recognition. For the Nordic countries, governmentally directed research funding requires a collaborative approach. To achieve significant results, this kind of projects are often designed homogenously, by putting focus on a single industry or discipline. The presumption is that problems are isolated to specific industries or disciplines, such as the construction trade.

According to Neve *et al.,* (2017), the construction industry is falling behind the performance of other industries in terms of quality and efficiency. A common reference to support the description is Winch (2003), who states that the construction industry is a 'backward' industry failing to be innovative compared to other sectors. Further, Dubois and Gadde (2002a) argue that short-term goals are prioritized over

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innovations. The prevailing culture and an inherent ability to change are put forward as explanations (SOU, 2002).

However, Löwstedt and Räisänen claim that it is a myth that "the construction industry is conservative and slow to change" (Löwstedt and Räisänen, 2012, 2014) putting forward the complexity and nature of construction as explanations for the moderate pace forward. Winch (2003) points out that the auto industry, often put forward as an exemplar, is not doing any better in terms of productivity, than the construction sector. Moreover, innovation in construction is rather driven from client dissatisfaction (Winch, 2003).

To thoroughly scrutinize a multifaceted problem, a multi-disciplinary approach is suggested, arching over multiple industrial practices. This aligns with “the Medici effect” (Johansson, 2004) stating that true inventions and breakthroughs are never the result of incremental improvements within single disciplines.

For construction management research, the balance between scientific rigour and practical relevance is a continuing issue. To balance these two domains, Ellström (2007) suggests a model with two interacting cycles to create knowledge. Aligned with the model proposed by Ellström, Voordijk and Adriaanse (2016) have investigated engaged scholarship, where the basic assumption is that academic and professional knowledge represent different, but related domains. Van de Ven (2007, 9) defines engaged scholarship as ‘a participative form of research for obtaining the different perspectives of key stakeholders (researchers, users, clients, sponsors, and practitioners) in studying complex problems’. Voordijk and Adriaanse (2016) concludes that practice research, design research and action research are presupposed to each other. Thus, collaboration becomes an integral part. Further, Kokkonen (2017) argues that "collaboration as a phenomenon is multidimensional and therefore research has vaguely applied the concept". Further, with support from McCaffrey *et al.,* (1995), Kokkonen (2017) stresses that participation works as a mechanism for collaboration. Participation can absorb complexity and consequently work as a management tool (Ashmos *et al.*, 2002; Kokkonen, 2017).

Corsaro *et al*., (2012) have scrutinized heterogeneity in innovation networks and identified six factors of having impact; (1) goals; (2) knowledge base; (3) capability and competence; (4) perceptions; (5) power and positions, and (6) culture. Still, the interplay between the actors’ features and how it impacts innovation outcomes must be further investigated.

The purpose of this paper is to describe a cross-industry and cross disciplinary approach to co-creation of knowledge through a collaborative research approach. A collaborative research project on the topic communication regarding customer specific demands is presented. The project includes two construction companies, a housing company with off-site manufacturing and a small subcontractor manufacturing street doors and front doors. There are also four other companies in the project within mechanical manufacture, telecom and consultancy. Previous collaborative research projects have resulted in clear and measurable results for the participating (and recurring) companies indicating increased learning, better communication and understanding of the actual problem or unit of analysis. The experience has been used in the design of the current project.

METHODOLOGY

Research Approach

This paper focuses on describing a cross-industry and cross disciplinary approach to co-creation of knowledge through a collaborative research approach. To fulfil the purpose of the paper, a multi-method approach is adopted. First, a conceptual model describing a conceptual research approach is presented. The purpose of analytical conceptual research is to add new insights into traditional problems, through logical relationship building. Those studies usually employ case study examples to illustrate these conceptualizations (Wacker, 1998, 373, 378). Thus, an empirical illustration is provided for the approach. In line with Lacoste and Johnsen (2015); Piekkari *et al*., (2010) we have thus used 'tacit knowledge' gained through immersion in the field to guide our retrospective analysis of previous and current research approaches.

Collaborative Research Design

The research design presented stems from lessons learned of the KKHÖG projects KOPeration (Dnr 20080537) 2009-2013, KOPtimera (Dnr 20130150) 2014-2016 [henceforth referred to 'the KOP-projects'] and The Whispering Game (Dnr 20160326) 2017-2020 (on-going). The research design has been incrementally refined throughout the projects by continuous feedback (evaluation surveys for both academic and industrial researchers at the closure of every workshop that have been summarized and discussed at the subsequent steering group meeting) and continuous improvements. The research objective and research design for all three projects have been jointly formulated with the industry (Bäckstrand and Lennartsson, 2016; Wikner and Bäckstrand, 2008; Wikner *et al*., 2013) and the final report for the two completed projects (Wikner and Bäckstrand, 2013; Wikner *et al*., 2017) constitutes a summary of actual results for each participating company. In summary, these three projects can be regarded as extensive engaged scholarship (van de Ven, 2007), also referred to as longitudinal immersion, that according to Wells and Nieuwenhuis (2017, 48) is defined as:

> … the situation in which the accumulative insights generated through knowledge acquisition in multiple diverse research settings, criticality and reflexivity are repeatedly tested against multiple aspects of practice through sequential and overlapping engagements with businesses, regulators, non-governmental organizations, consultancies in the quest for applied impact on [the intended industry].

Description of the Empirical Illustration - the Whispering Game

Competitiveness is dependent on customer satisfaction and delivery of required products. A challenge in manufacturing is to be, both efficient and contribute to high effectiveness, i.e. customer satisfaction (Heikkila, 2002). Also, the manufacturers need to be responsive to comply with changing customer demands. In recent years, a multitude of manufacturers has experienced an increased demand for customized products. Some of these customizations can be satisfied by a mass-customization or 'assemble-to- order' (ATO) strategy. However, not all products can be ATO, some product customizations have impact on the product design. Hence, the products must be engineered-to-order (ETO), rather than trying to standardize or modularize the product mix, the project focus at management of the current situation with increased demand for customizations in a more efficient way. Gosling and Naim (2009) identified construction as a sector dominated by firms employing an ETO strategy, and by the addition of four more ETO-oriented companies the project is suitable for the collaborative research approach. The clients' ability to manage information has

been reported in Levander *et al*., (2011) with focus on uncertainty and equivocality and Engström and Stehn (2016) where the project logic is put forward as a barrier.

For manufacturing companies offering customized products, the customer requirements can be represented by 'customer-order specific information' (COSI) (Wortmann *et al.*, 1997, 72). To fulfil customer requirements, the focal actor needs to be able to capture the COSI from the customer, which is subsequently communicated clearly to the internal supply chain, i.e. among the various functions within the focal actor and also the external supply chain, i.e. the suppliers, see Figure 1.

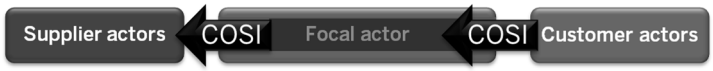

Figure 1. The transfer of COSI in the Customer - Focal Actor - Supplier triad.

The Whispering Game project formulation (including definition of scope and project direction) was initiated 1.5 years before the launch. This rather long project formulation process has been important to fully grasp the business partners' needs (Company A-F) and the project scope has been developed jointly by the industrial researchers and the academic researchers. The purpose of the project is to achieve customer satisfaction by developing a way of working that supports efficient COSI-transfer, both internally and externally.

Business Cases

Hard facts regarding the participating companies are presented in Table 1 to illustrate the heterogeneity and cross-industry setting of the project. Short descriptions of the participating companies.

Off-site housing (A): The Company offers single-family houses on the private market, built up from volumetric elements and produced off-site. The products belong to a standard series, but customisations are allowed.

Subcontractor (B): The Company offers doors and gates which are produced in a small artisanal workshop. Most orders are customised and clients arch from condo associations to large contractors.

Telecom (C): The Company belong to a large global group and offers services, software and infrastructure in information and communications technology for telecommunications operators.

Mechanical Manufacturer (D): Offers tailored solutions to other companies within the engineering industry.

Mechanical Manufacturer (E): Offers heat exchangers on the global market.

Consultancy (F): Independent consultancy firm residing in Scandinavia with clients within manufacturing, services, public sector and defence.

Table 1. Business case overview

	A	B	C	D	E	F
Customer	B2C	B2B/C	B2B	B2B	B2B	B2B
Turnover (MEUR)	44.8	3.3	19,876	21.0	44.5	173.4
No. of employees	198	22	100,735	121	123	1,439
No. of members in project	1	2	1	2	1	1

Academic Group

The academic group consists of five members with the following profiles. Hence, also the academic researchers represent heterogeneity and cross-disciplinary research interests.

Project leader, Ph.D. - Primary competence in purchasing.
Ph.D. - Competence in construction, off-site production and control.
Ph.D. - Competence in interplay and learning in groups and organisations.
Ph.D. Candidate, M.Sc. - focus on industrial technology and customisations.
Ph.D. Candidate, M.Sc. - focus business and IT alignment, enterprise architecture and modelling

RESULTS AND DISCUSSION

The scientific approach of the research project is based on collaboration and co-creation of knowledge, where both the academic researchers and the industrial researchers take an active part in refining the formulated research objectives, and in developing new knowledge (The project participants from the business partners are referred to as 'industrial researchers' to emphasize that they are not passive by-standers that the academic researcher conduct research on). This is referred to as collaborative or interactive research (Ellström, 2007). In an interactive research process the academic and industrial researchers interact for joint learning but have different roles and different interests regarding the outcome of the research (Larsson, 2006). A common way of illustrating the joint knowledge creation through interactive research is the two interlocked learning cycles representing the practice system and the research system presented by Ellström (2007), see Figure 2. The iterative and interactive approach is the basis for the research, but contrary to the Ellström model, data collection and data analysis is carried out by both the academic and the industrial researchers.

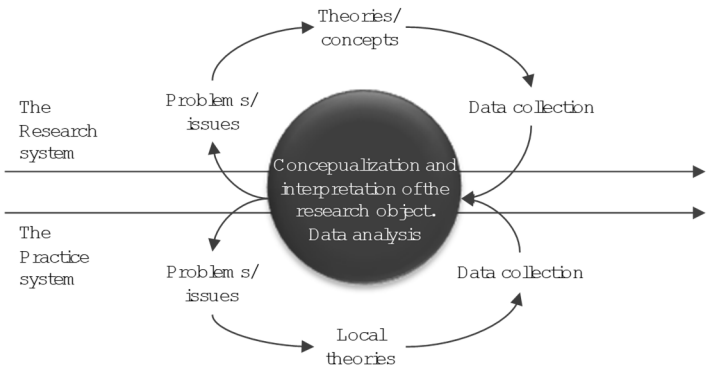

Figure 2: A model of knowledge creation through interactive research, based on Ellström (2007).

The project work is organized around recurring workshops, where the industrial researchers interact with each other and the academic researchers (this is the point of joint conceptualization and interpretation in the Ellström model). The workshops are ambulating among the business partners and the academic institution and is also an opportunity for observations including all researchers. During the former KOP-projects, the workshops have been found to be rewarding and the companies discovered that their problems were much alike, although they operated in different industries and manufactured different products (in terms of value, size, lead-time, and

level of customization etc.). The workshops also played a significant role regarding data analysis and conclusions.

Each workshop is associated with a work package containing data collection, data analysis and conclusions. Each work package covers four months of parallel activities, see Figure 3. From the project application, each Research Question (RQ) is processed in one or more work packages depending on the extent of the RQ. The work package is initiated by a planning-focused steering group meeting where a "homework" for next workshop is agreed, as well as the way of working. Since the same unit of analysis is investigated at all companies, this can be compared to a multiple case study with holistic design according to Yin (2014, 50).

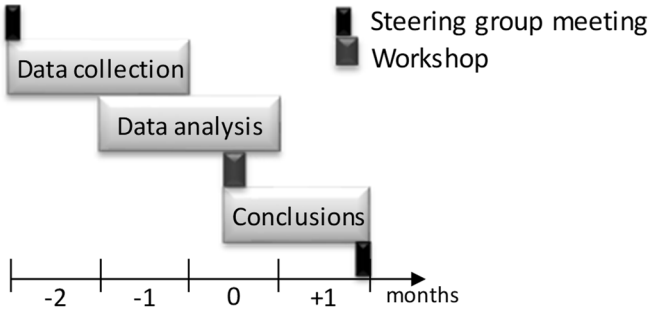

Figure 3. The generic work package associated with each workshop

The steering group meeting is followed by a two-month period of data collection and initial data analysis. This stage can be carried out as work meetings (where the academic and industrial researchers spend time at the other's site) or individual work by the industrial researchers (together with their co-workers at the respective business partners). Parallel, the academic researchers are conducting literature studies or analytical conceptualizations (Wacker, 2008). The results from the homework are presented at the workshop and joint data analysis is carried out (e.g. cross-case analyses) and the formation of conclusions commences during the workshop.

The workshop is succeeded by a month of conclusions or implementation and testing. The work package ends with a follow-up steering group meeting where lessons learned are gathered and the result from the workshop evaluation is summarized. Based on the results the next work package is planned for, both in terms of WHAT to do and HOW to do it. Thus, each work package is associated with a deliverable. Accordingly, even though illustrated in a sequential manner in Figure 3, a set of work packages can be seen as an iterative cycle where the steering group meeting both close the work package and initiates a new cycle, which can be compared to the action-reflection cycle (Coghlan and Brannick, 2010; McNiff and Whitehead, 2011). This means that data collection, data analysis, and conclusions are performed continuously during the research project, although there are some sequential steps associated to each workshop. The activity plan for the project includes 3-4 workshops per year (in total 10 workshops over a three-year time span), depending on the needs of the academic and industrial researchers, see Figure 4.

The deliverable from the initial work package is an established "as is" base to find a desired "to be" scenario on and to measure project improvements towards. The final workshop is dedicated to fulfilling the purpose of the project. The intermediate work packages focus on the deliverables stated for each project.

There are also two workshops planned not associated with a work package, the initial kick-off and the closing conference. The initial kick-off focuses on establishing a

trusting environment among all participants to create favourable conditions for the project.

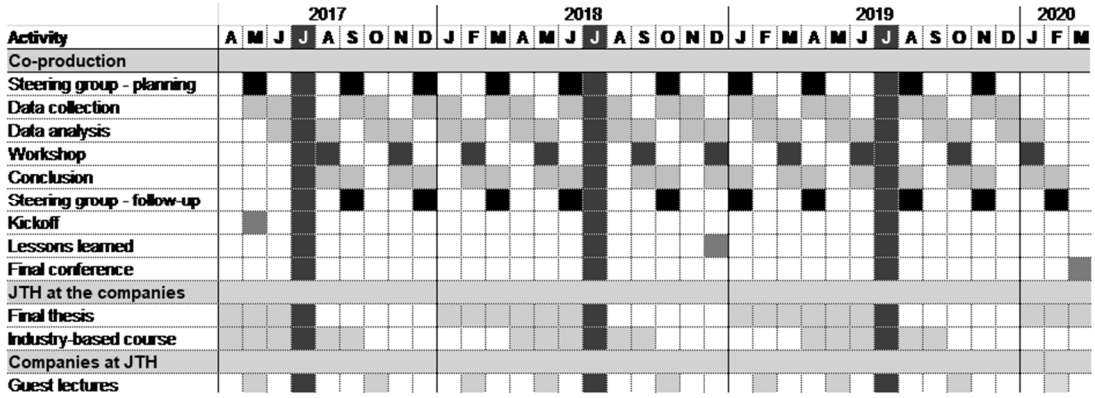

Figure 4. Outlined activity plan for the Whispering Game project

The final conference is intended to wrap up the project and to create a forum for communicating the project results both to a broader audience within the business partners and to non-participating companies and institutions. Also, these activities are benchmarked from the KOP-projects. Other activities, not necessary within the project, but nonetheless strengthening the relations between the academic institution and the business partners, are master's and bachelor's theses, a 5-7-week industry-based internship course for students and engaging the industrial researchers as guest lectures at the university.

All work packages require the academic researchers and industrial researchers to collaborate and co-produce, both with each other and in the own organizations respectively. At some of the workshops, other academic guest speakers are invited. They represent a different, or adjacent perspective of the current focus area, compared to the permanent academic researchers. This procedure has become customary in the KOPtimera project and has received a very positive response and evidence of knowledge creation from the whole working group.

When needed, complementary empirical data are collected through interviews, documentation analysis, direct observations and participant observations. The participant observations provide opportunities to gain access to events that are otherwise inaccessible to scientific investigations (Yin, 2014, 116) and for this project it involves the academic researchers visiting the companies to work together with the industrial researchers to help with data collection or analysis, or implementation of the results. The empirical data from each case are analysed using theory and through cross-case analyses. Relevant literature is studied in parallel with the empirical studies in line with an abductive approach (Dubois and Gadde, 2002b).

Workshop - General Planning - Evaluation

The workshops, that are the core of the collaboration, started out as full-day meetings but soon evolved to lunch-lunch meetings and are now tending to extend to a full day plus a half day. In Table 2, a tentative overview for each workshop is presented.

Thus, every workshop ends with a written and oral evaluation of the preparation for the workshop (homework), the realization of the workshop, the most significant learning or experience and suggestions for improvement. The results from the evaluation is discussed at the following steering group meeting and the agreed improvements are implemented instantly.

Table 2. Overview of the general planning for each workshop

Day 1	Day 2
Gathering, informal greetings	Joint analysis
Company visit/tour	Theoretical input
Joint lunch	Formulation of homework
Presentation of homework by companies	Summary and evaluation of WS
Joint dinner	Joint lunch

Results - Collaboration

A serendipitous result of having the workshops planned lunch-lunch (or longer) is that by including dinner and leisure time together, all project participants get to know each other and build trust each other, which has created an open and trusting work environment where also "sensitive data" such as weaknesses and poor decisions can be shared and discussed. From a research point of view this has been very beneficial since core issues rather than superficial problems can be addressed, thus adding to the relevance of the research.

Robustness of the Approach

In the paper, the heterogeneity of the approach has been promoted as positive. Of course, it is possible to point to limitations when managing a group of both organisations and people representing a variety of domains and backgrounds. Also, as for any collaboration effort including a significant number of individuals and/or organisations, there might be disturbances if anyone leaves or a new contender enters. There may also be concerns regarding the data quality gathered from the prescribed homework assignments that have been distributed to the industrial researchers with less formal academic training.

However, the iterative approach presented (Figure 2-4), which also arcs over consecutive research projects (including recurring companies), prove that the approach is solid and that the long-term perspective builds a culture, that conversely to some of the cultural manifestations in construction, has a positive influence. The approach nurtures participation which is also observed by Kokkonen (2017). Also, as for any projects of course the project scope and definition is crucial for commitment of the participating partners, both industrial and academic.

CONCLUSIONS

The purpose of this paper was to describe a cross-industry and cross disciplinary approach to co-creation of knowledge through a collaborative research approach, which has been done. To be successful with such heterogeneous set-up, the project execution has to be solid and well-planned. To engage the companies, the project emphasizes activities which are not adding any immediate contribution to academic production. Networking, industrial education, publications in trade journals, participation in trade fairs etc. might be essential in order to convince the industry of the practical relevance of both previous and future projects. The approach is supported by the argumentation from Kokkonen (2017) and importance of participation as a mechanism for collaboration.

The findings align with the results from Voordijk and Adriaanse (2016) regarding engaged scholarship that practice research, design research and action research are presupposed to each other, in the sense that applied research does not necessarily need

to be isolated to specific industries or disciplines, as the collected data are applicable to the different participating companies' despite of their differences.

From the supposition that the approach has succeeded to build trust among the participating companies, it would be interesting to investigate the impact factors proposed by Corsaro *et al*., (2012) within the frame of the project.

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