

# **Inter-organizational collaboration in the field of construction: the perspective of an engineering consultancy.<sup>1</sup>**

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**Abstract:** In this work in progress we consider the challenges of inter-organizational collaboration in building projects to support higher quality and lower prices. The framework of Carlile (2004) is used to identify and categorize the current situation and needs of different knowledge processes: transfer, translation and transforming. We discuss recent and ongoing initiatives at various levels within the building industry (government, industry, company). The initiatives are discussed from the viewpoint of an engineering consultancy company. The study reveals that a more integrated process across partners in the building industry provides improved quality. However, new needs arise and development of new knowledge processes is required to exchange, understand and negotiate the knowledge needed in closer collaboration. Development of these knowledge processes is complicated and there is a need for both industry-wide and more local steps to initiate it. Not at least due to the fact that the internal management of knowledge in the organizations involved is confronted.

**Keywords:** inter-organizational collaboration, knowledge processes, knowledge management, information and communication technology (ICT), building industry, engineering consultancy, KIBS, case study

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## Background and motivation

In the last decade there has been a sound critique of the Danish construction industry. It is argued that buildings are too expensive and the quality too low (The National Agency for Enterprise and Construction (2002)). In addition, the fear of growing international competition makes the players aware that changes are needed if the Danish building industry wants to remain competitive. Several factors are assumed to contribute to the problems: inefficiency, high prevalence of errors and flaws, legal handling of conflicts of responsibilities, and lack of transparency in prices of material reducing competition. Inefficiency and the high number of errors and flaws are to a large extent seen as related to the division of labor found in the process of constructing buildings. The process of constructing buildings in Denmark is in general divided between three separate types of companies: architectural companies taking care of the design, engineering consultancy companies calculating, planning and preparing the construction, and the construction company building the construction. The normal procedure is a stepwise process with a serial relation with some overlap between the different companies: the output of the architects in the form of an architectural design is the basis and frame within which the engineering consultancy companies work out a detailed plan with solutions considering choices of material, sequences, forces, weights etc. The chosen building contractor and the subcontractors construct the buildings based on the detailed descriptions and plans from the engineering consultancy companies.

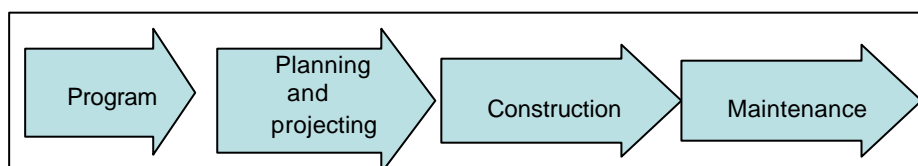


Figure 1. The main phases of a building project (inspired by the Ministry of housing and Urban affairs (2000) p. 11

The division of labor, the priority of specialization and the highly sequential process pose challenges of integration. This is even more prevalent in companies such as Ramboll mainly involved in unique building projects (e.g. the Opera House in Copenhagen, Denmark) as opposed to designing and projecting standard houses.

Recently, different initiatives have been launched and supported by the government, both on an industry level and within and between companies to resolve conflicts and reduce inefficiency and errors. In this paper we focus on analyzing local initiatives and those launched by bips<sup>2</sup> (Building, Information technology, Productivity and Collaboration). bips is a non-profit membership organization of companies within the building trade, whose members comprise all parties within building. bips's aim is to develop collective tools and methods to aid collaboration between all players involved in the construction of buildings. bips's initiatives are

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<sup>2</sup> [www.bips.dk](http://www.bips.dk)

mainly financed through member fees and are sometimes supported by governmental grants.

By looking at the initiatives from bips as well as other more dispersed and local initiatives, we take the perspective of the engineering consultancy company Ramboll<sup>3</sup>. We are especially interested in bips's initiatives as they are industry-wide and all depend to some extent on the use of ICT (information and communication technology): either as a network to secure or provide updated versions or as the platform for communicating between the organizations. Some of the initiatives investigated are 1) the development and use of standards defining responsibilities of each partner within the construction projects 2) the development of shared language and 3) the development and use of collective ICT standards and infrastructures to make digital working processes work across inter-organizational borders. The potentials of these initiatives are to provide possibilities to exchange material, reuse or manipulate data and documents, and reduce conflicts through well defined responsibilities and roles.

To investigate the extent to which these initiatives are successful or sufficient we discuss problems and insights from an empirical viewpoint as to how these initiatives are viewed and have impact on the work of the engineering consultancy.

We introduce the framework of Carlile (2004) to give theoretical coherence and perspective to the discussion. Carlile (2004) discusses the prerequisites and need for knowledge processes in innovative collaborations between partners from different domains. The framework discusses three essential types of challenge and the need for different solutions or initiatives. This conceptualization is helpful to categorize and discuss the conceptual differences in needs and initiatives.

The case of inter-organizational collaboration in the building sector is one among several case studies in the Eservice project ([www.eservice-research.dk](http://www.eservice-research.dk)). In the E service research project, knowledge services produced or delivered through ICT networks are investigated. The focus of the research project is entrepreneurship and innovations in E-services and the consequences for business, customers and citizens. As a joint research project participants come from three different organizations namely: Center for Service Studies at Roskilde University, Center for Information and Communication Technologies at the Technical University in Denmark, and NewInsight A/S (a consultancy company). The project intends to develop scenarios providing insights on trends and opportunities regarding the production and use of E-services.

### **Theoretical framing**

Carlile (2004) argues that developing new products as a divided process with innovative contributions from a number of collaborating and specialized domains requires considerable attention and support to be successful. There is a need to secure integration between the different parts; innovation in each domain must be on the

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<sup>3</sup> [www.Ramboll.dk](http://www.Ramboll.dk)

premises of the product in total. Some innovations in a domain might not have consequences for the other domains and an overall fit, but other innovations or decisions do. There is thus a need to manage and negotiate knowledge on different alternative choices and the influences across the domains involved if the innovations shall lead to successful innovation. According to Carlile the importance of this kind of knowledge sharing and coordination grows with the level of dependencies and differences between the different domains involved. It also grows with the level of novelty involved; this challenges the existing balance of shared knowledge developed, and acknowledged between the different areas.

Departing from the Information theory of Shannon and Weaver (1949) Carlile (2004) defines three levels of communication complexity: syntactic, semantic, and pragmatic. The syntactic level is the first level as it is the basic of all forms of communication providing an ability to transfer knowledge from one part to the other through the use of different media. Knowledge transfer is the main boundary when there is a shared base of knowledge or what Carlile refers to as a collective lexicon of differences and dependencies. This situation applies only to situations of stable conditions such as routine projects. When a semantic boundary is faced it implies that unsettled ambiguities such as unclear differences or dependencies exist; a new type of knowledge processes named translation is then needed. These processes aim at creating shared meanings or reconcile differences in meaning through processes such as externalization of knowledge. Processes of externalization or codification are discussed quite extensively by eg. Nonaka et al. (1996) or Boisot (1998). Shared methodologies such as CAD/CAM templates are mentioned as a concrete example of a tool to provide for knowledge translation at a boundary. On the highest level of communication complexity we find the need to negotiate differences of interest when novelties interfere with the existing order or balance. This level is called transforming knowledge by Carlile (the boundary is called pragmatic or political). At the pragmatic level solving differences might generate cost to some of the participants. There might be a need to change either domain specific knowledge or collective knowledge to make room for innovations. Changing the knowledge acquired is costly it takes time to learn and it takes time to change the current knowledge integrated in practices and thus patterns of thinking. Different tools have been recognized as resources to negotiate interest and point out differences to be solved. The process of negotiating differences is of course even more complicated if different economical issues are at stake.

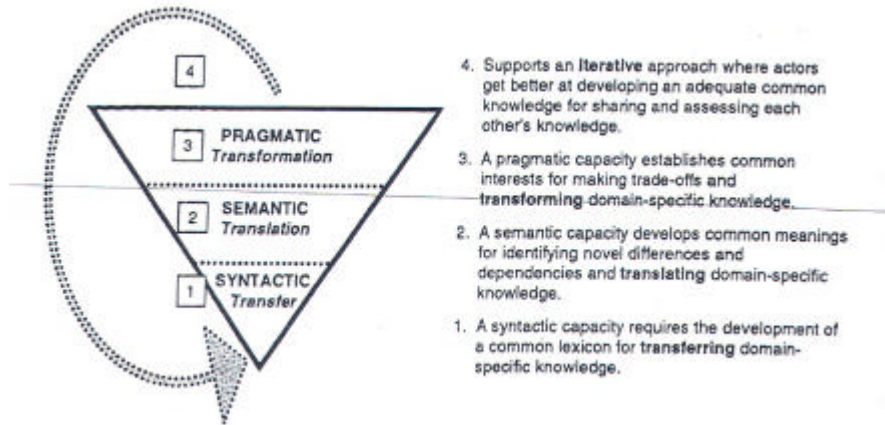


Figure 2. 3-T Framework and the Four Characteristics of a "Pragmatic Boundary Capability" (Carlile, 2004 p.563)

The theory thus suggests that shared language and understanding is a prerequisite for cooperation, but as soon as novelties introduces differences in one or more domains introducing unknown consequences for other domains there is a need to negotiate the relations. In some situation this can be settled through the creation of a new joint understanding, in other cases differences are more profound and require negotiation of conflicting interests and changes in the existing knowledge bases.

The identification of these three different types of boundaries and knowledge processes indicates that essential differences in collaboration challenges are in need of different solutions. If you have a problem of interest or interpretation this is not solved by additional transfer of knowledge. In addition, problems of transfer or translation are not solved through the negotiation of interest. Yet another issue is the leveling of the different boundaries. The different levels indicate that the first level of knowledge transfer is a prerequisite for the following two levels etc. Another process worth mentioning is number four in the model. Carlile argues that the required knowledge processes are not easily established as they are often complicated and interrelated. There is therefore a need to repeat the processes to grasp and settle the differences. If the environment is unstable there is a need to address the boundaries and knowledge process on an ongoing base.

Applying the framework of Carlile to the case of collaboration in the building industry is stretching the ideas of Carlile a little further. In the article by Carlile the framework is used to discuss the challenges between different domains inside a company. However, we will use it to discuss initiatives to support cooperation in the building industry and thus in inter organizational settings. We believe this is possible as the challenges in building projects to a large extent can be conceptualized the same way as Carlile conceptualize the challenges in internal collaboration. Building projects involve a number of separated companies but as the inter-organizational interdependence is high a somewhat similar situation is at stake. The same kind of boundaries can be identified but the challenges at each boundary might be slightly different, e.g. either stronger or weaker in significance. A major difference between

internal and inter-organizational collaboration seems to lie at the pragmatic boundary with the process of knowledge transformation, where differences of interests are negotiated. within a company these differences mainly address power issues and differences in knowledge bases between different departments. In an inter-organizational project however, the responsibilities and economic aspects are more differentiated, optimizing across the whole building process is thus less likely if not all parties gain from a given change. In addition it probably feels less natural and it is more cumbersome to build up experience across the organizations involved, especially in this field where partners are shifting.

### **The empirical setting**

Here we approach issues on collaboration in building projects mainly from the angle of the engineering consultancy Ramboll, which is one of the three biggest engineering consultancies in Denmark. This approach provides a limited viewpoint on the collaboration challenges addressed. However, it offers the possibility to more closely observe the link between collaboration demands and the internal organizational issues in one of the organizations involved. A more comprehensive analysis would require the perspective of other organizations in the building projects.

The construction division in Ramboll is mainly involved in unique and sophisticated building projects; buildings are the result of close interaction with customers as well as architects and constructors defining needs and developing solutions.

In Denmark building projects often involve a number of different participants. Usually the work is coordinated through the recognition of the four building blocks where different players normally are seen as the main driver. The building owner which is either the customer or represented by an engineering consultancy is involved throughout the process. In the phase of program it is the architects delivering the product, whereas the engineering consultancy (another than the building owner) is responsible for delivering a more detailed plan and project of the building on which the contractors can make a tender. The construction involves a lot of subcontractors and suppliers, but often one head-contractor has the overall responsibility. Another model of the building process is more detailed according to different steps in the process. Again, it is a stepwise project description with clear borderlines at least on paper! The seven phases model is developed based on The National Agency for Enterprise and Construction (2003).

1. Idea and programming
2. Opportunities
3. Projecting
4. Competitive Tendering
5. Production preparation
6. Production
7. Maintenance

In the first few phases it is mainly the building owner and consultants (both architects and engineering consultants) that are involved and to some extent the authorities. These phases concern formalities such as contracts, permissions as well as the knowledge services of designing and projecting solutions. This results in detailed material; drawings and plans, on which constructors can make a tender. From here constructors, subcontractors and suppliers gets involved in addition to the already mentioned actors. More contracts are made and the construction field and work site conditions are planned. The building is then constructed including controls and delivery procedures and final settlement. At last responsibilities on maintenance are established.

This process can be approached as a mainly sequential process (Thompson 1967), where each phase present a well defined tasks and clear responsibility as more or les illustrated in the seven phases model above or the four phase model presented earlier. It is however problematic to present it as a well defined and stepwise process as strong dependencies exist between the different partners. The solution or choice of one company is framing the alternatives of the next. Developing good solutions (in terms of quality and price) thus requires mutual adjustments (Ibid) between the different partners, where the dependencies and consequences are well understood and handled (Carlile 2004).

## **Method**

The case study took place during 2005 with field site interviews in Ramboll in mid-2005. We made 13 interviews of 10 different respondents placed in the company headquarter or in one of the regional offices. These respondents represented different levels in the management structure, from the CEO, to the IT-director and HR-director as well as department leaders and project managers involved in the daily work of projecting and designing. We presented the HR-director with a list of themes we wished to address. He in turn selected respondents and asked them to participate. All interviews took place at the company site. The interviews were semi-structured; we followed an interview guide with a general section as well as a customized section based on the respondent's occupation and area of expertise. We also included questions along the way based on the information and insights gained in earlier interviews. This approach made it possible to stay open to new issues of interest as well as to get deeper into particularities. Apart from the dialogue respondents demonstrated standards and systems in use to give us a more concrete understanding. They also provided us material on systems evaluations and other internal material such as a humorous pamphlet on the main challenges in project work. Each interview, lasting 1-2½ hours, was either transcribed or reported extensively. These interviews were analyzed thematically: firstly through the use of the themes that guided the interviews; later through new themes rising from the first round of analysis as well as themes growing out from the application of different theoretical lenses used to analyze the material.

Apart from the company focused study other materials regarding cooperation in the building sector was found and used. The bips website was visited and materials from here obtained. We also found other sources of interest such as reports and websites

providing descriptions and perspectives on the situation, including evaluations of initiatives to support the building sector; this material was mainly from governmental institutions.

## **Cross-organizational collaboration in the building industry**

In the following the situation of the building industry is described to provide an understanding of the challenges faced. We focus especially on situational issues pertaining to the problems or challenges of inter-organizational collaboration. Again, it is important to note that we take the engineering consultancy as our frame of reference. Afterwards, we present and take a view at some of the initiatives taken in the recent years: governmental directed initiatives, industry initiatives, as well as organizational ones. In the analysis we use the framework of Carlile (2004) to discuss to what extent the initiatives seems to address the actual needs or if other or additional steps should be taken. Lastly we discuss the role of ICT in the different initiatives.

### **The situation for collaboration in the building industry**

Part of the problem of inter-organizational collaboration seems to be one of coordination which is exacerbated through the combination of a number of several factors. As already mentioned the building process is quite complex and requires close cooperation between all partners and according to Carlile (2004) thus an understanding of the dependencies and differences between the different actors involved. Coordination has become even more complicated as the number of involved participants has risen due to high specialization; most tasks are chopped up into highly specialized areas and actors. In other sectors involving a lot of partners in complex interrelations, coordination mechanisms has developed not only at an internal level but industry wide (Ministry of Trade and Industry (2000)). However, the lack of collective standards at the inter-organizational level in the building industry is possibly because no single organization has had the power to set *de facto* standards or because the need has not been as prevalent as today. The standards missing address different issues and levels: at the technical level **file formats** are needed to make it possible to open and read material from others; such as drawings. Also, there are advantages as in the creation of **collective symbol systems**, as well as disadvantages; tools developed for certain areas might cover more particularities of that practice, whereas a collective system helps reading material across domains.

On a broader level a need for **formalizing and coordinating the responsibilities** involved is felt. The limits between deliveries are often dynamic and complex; there are thus advantages gained if expectations are clarified at earlier stages of the process.

Again, introducing new and collective systems mean that each organization or actor needs to learn and get accustomed with a new system or new symbols and there by transform the knowledge of using existing systems. According to the framework of Carlile these problems mainly address issues of knowledge transfer and translation as they ease exchange or understanding. But as any type of change means that other



changes are needed this may also require knowledge translation through learning or unlearning on a however low level.

In some inter-organizational process the need for formalized coordination mechanisms are reduced. The experience is that this is the case in repeated constellations of cooperation. Here, informal practices as well as a mutual consideration seem to develop due to a **closer relationship**. The first part means that roles arise as well as an informal division of responsibilities. Moreover, closer relationships seem to develop a more responsible attitude across the project and thus more care and understanding of the other organizations situation. This reduces the level of conflicts; problems are solved much earlier as there is a wish to do so. However, frequent repetition of partnerships is seldom the case. According to Carlile's model this is unfortunate as repetition and ongoing handling of borderline issues help in dealing with these problems in the long run: better solutions can be made through several iterations; experience in negotiating these issues eases future conflict.

As mentioned before there is a growing understanding that closer and more **mutual adjustments** are needed to make sustainable solutions across the organizations. This implies a need to approach the process of building projects as one of mutual adjustments instead of a serial relation. If so regarded the dependencies and differences must be made explicit and recognized to another extension, including working and choosing from **different alternatives**, developed on the bases of the knowledge from the different participants influenced. To make this happen there is a profound need at all boundary levels. The process of knowledge translation becomes essential and dependent on how the needs changes, the internal processes within the different companies transforming knowledge might have far reaching consequences.

Another problem area which is recognized address economic issues. Again, it is the combination of a number of factors that proves problematic. Overall there is a problem in having the process of constructing buildings broken into tasks taken care of by **economically separated organizations**. It is unclear why this division is maintained. There seems to be two reasons: a historically grounding in the educational system (Ministry of Trade and Industry (2000)) and a request from insurance companies. The divided process is mainly a problem as the differentiated tasks are highly interrelated. This means that problems in one phase of the project are either overlooked, or solutions are taken pushing the problem or cost to a later phase and another organization. Such an approach and attitude result in a lot of expensive conflicts. This problem is even more prevalent today as all bids are in competition and some bids might be "wishful thinking" as projects (earnings) are needed. The combination of bids and fixed prices rather than working on account proves problematic. If or when budgets do not hold either because they were set to low or because unforeseen cost arise, different solutions are around: lower the quality, make shortcuts, push cost to partner, or invent elements not covered by the contract to make it possible to bill the customer. The HR-director complains that fixed prices and bids has made the area of construction to business oriented

There thus seem to be a conflict in tender to assure low prices. This discussion points to a profound need of knowledge transformation as clashes of interest exist, due to separated economies that seems to limit a more integrated approach to building projects.

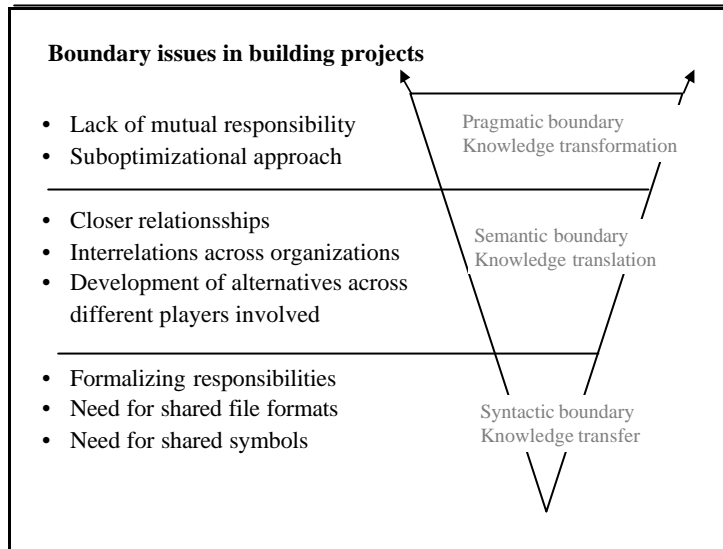


Figure 3. Suggested boundary issues in inter-organizational building projects

According to the discussion above there are needs at all three boundary levels that need to be met if the building industry is to become better at supporting innovation across organizations and provide higher quality and more reasonable prices for the end product.

### Initiatives to improve collaboration in the building industry

There is a growing understanding of the need for change in the building industry. Most companies are involved or support initiatives like bips. bips is an organization that promotes different uses of ICT to make the building industry more competitive. More ICT is implemented and changing approaches to building projects are changing the practices in the engineering consultancy business, as found in Ramboll. In the following we discuss some of these initiatives and the extent they succeed. We also consider whether there are inconsistencies or drawbacks to the initiatives, as well as the role of ICT. ICT is seen as a main driver for change but it is also recognized that ICT is only part of a solution. We will therefore look closer at the potential that ICT seems to offer.

Some of the initiatives in bips are seen as a way to provide the foundation for closer collaboration. Some communication technologies are highly standardized such as e-mail clients, meaning this communication tool is available making it possible to communicate both within and across organizational borders in an easy way. This can support ongoing communication and coordination and sharing of material through attachments. Another specific means for communication that has been developed and

promoted in building projects is the one of shared Projectwebs across the different partners involved. They are not used extensively: first because there are other and easier ways to communicate; and secondly the common archival function is of limited usefulness as each company is required to have their own archive.

The development of **common formats** is extremely important. These formats makes it possible to share and combine data. An example is the integration of different 3D models from companies modeling different elements in the same project. The use of common file formats makes it possible to combine the two models and see if the models fit or reveal the misfits. This is possible, even different software systems are being used. The common file formats provides for the transfer of knowledge whereas the 3D models are translating knowledge – dependencies and differences between the different domains and thus organizations involved.

Another issue is the development of **standards defining responsibilities** of the different players and not at least the borders in between. We were presented to such a standard within the field of concrete. These standards cover overall responsibilities; tasks, deadlines etc. They also address more specified tasks. The standards are meant as templates to depart from in the contractual negotiations. They help in making clear agreements on the division and content of work responsibilities as they help in making more explicit statements on what and how work within the field is to be done. It is possible to make changes and thus adjust the standards in the specific project, but any change should be written into the formal template and agreed upon by the different partners involved. The standard is thus flexible and prescribes a method on how to deal with this structuring in a flexible manner. This formalized approach is made in order to eliminate or reduce the problems of conflicts of shifting problems and responsibilities around between the involved organizations. Developing these standards is thus a way to define and discuss the differences and dependencies between the different participants and can be seen as initiatives to meet the challenges of knowledge transfer and knowledge translation. The HR-director is arguing that these standards help in developing what he calls a shared language among the different participants. ICT is an important part of the standard system as the use of web based technology makes it possible for everybody to access the same and newest version of a standard, as they are provided at a restricted website to all members. The role of ICT is thus to make it easy and convenient; reducing the reasons and excuses not to use the standards.

The standard within the field of concrete seem to have reached a form were it actually support and help in negotiating responsibilities. However, more versions of the standard have been on its way to reduce the chances of escaping responsibilities. These iterations point to the number four in Carlile's model explaining that these knowledge creating processes need to be repeated to make more robust solutions.

The downside of standardizing responsibilities is that this approach builds on lack of trust and loyalty within building; it implies rule based behaviors instead of moral imperatives. This indicates an environment which is not the most suitable for close inter-organizational collaboration.

Moreover, the use of responsibility standards might fix the borders between the tasks and thereby simplify the project and reduce the need to one of knowledge

transfer. The use of standards must be combined with other initiatives, to deal with problems of knowledge transforming if a more **shared approach** to innovation and inter-organizational collaboration is preferred. Optimization across the project rather than within the different contributing organizations requires to some extent that the involved organizations give up some of their knowledge base and require one that contributes to a shared one.

The National Agency for Enterprise and Construction (2000) has suggested different ways to support shared responsibilities and engagement across the different organizations and tasks. One solution is to develop a *better understanding* of the work and conditions of the different partners involved. Another solution is to introduce *financial incentives* such as an economical reward paid only if the entire project meets specified requirements; such as deadlines and quality. The financial incentive is thus meant to widen the business and financial interest of the players involved, this seems to be a suitable solution as economies seem to rule the world, as mentioned by the HR-director.

Even these financial incentives have not been used, there seems to be a growing collaboration between the different participants in some of the building projects where Ramboll is participating. This change seems to be rooted in a **changed attitude**; there is a growing understanding in Ramboll that the process of designing, projecting and building has to be seen as a highly interrelated process, where mutual adjustments are needed. It is thus a question of **closer collaboration** rather than a better understanding of the work and conditions. At Ramboll an initiative has been launched to make the engineers gain a better **understanding of construction issues through company visits**. Most engineering consultants lack an understanding regarding how the developed solutions work out at the building site; whether the solutions are complicated and expensive to construct or not. At these company visits different solutions, materials and working conditions are presented and discussed. This might be a good idea, but it is voluntary and time consuming, and limited knowledge is gained, whereas close collaboration is directly on the issues involved and provides for changes in understanding between all partners creating solutions better understood by all players.

The new way of looking at building projects as highly integrated has huge effects on the internal organization especially if the overall collaboration process is prioritized at the expense of more local innovations in the companies. This way of dealing with projecting is different from the current. Any invention affecting the entire project would thus need to be developed, approved or accepted across the collaborating partners to assure that it is in fact an innovation in the perspective of the entire project. This complicates local innovations and a need arise as to coordinating innovations across or communicate more intensively to coordinate, adjust and negotiate on the way. This requires a different practice and thus conflicts with the existing knowledge and practice on innovation in Ramboll. There is thus an **internal need to adjust the procedures of handling innovation**. According to the terms of Carlile this means processes of knowledge transformation, which is in its infancy at Ramboll.

**Close collaboration** has mainly been prioritized in relation to customers and to some extent with the architects, but there is a change here. There is a growing attempt

to get the different actors involved earlier in the process: when the architects start sketching to influence the design by developing different alternatives to be chosen from. Also **the constructors are found much earlier in the process**, to arrive at better and more economical solutions, by integrating their knowledge. This form of collaboration and crossing understanding is a way to optimize on an overall level through considering the interrelations between the different domains. This is to a large extent done through more interactive communication between the different partners. The new possibilities of 3D drawings used in projecting have proved to be a tool that really furthers the collaborative process. The **3D model of the building act as a so called boundary object**, it is a collective tool providing one model of the project. The model provides domain specific insights to the different partners and is thus an ideal tool for collaborating. Also, it reduces the level of mistakes as the model reveals lack of coherence (such as too long or too short beams). This coherence control reduces the mistakes made at the building site as the drawings reveal incorrectness. In addition the 3D drawings are easier to grasp as they are more comprehensive. The **integrating through communication and aligning models** is thus a process of knowledge translation, but it may also be one of knowledge transforming.

In the model underneath the different initiatives in Ramboll to support the inter-organizational collaboration is summed up. Projectweb is in brackets as it is not being extensively used and does not contribute significantly to the collaboration. There is no doubt that the most important change towards closer collaboration is the changed attitude, that this is needed and that the company needs to give up some of their sovereignty to support this. This changed attitude possible is an effect of the debate going on highly promoted from governmental organizations. So far there seems to be no reduced price level to be found. However, it is argued in Ramboll that the main gain is reduced errors and flaws as well as a higher quality due to more sophisticated design, which has come along with the use of 3D models. 3D seems all in all to be an important factor in making inter-organizational collaboration possible. This way of modeling unifies the different partners' approaches into one model and visualizes differences and dependencies. The move towards closer collaboration is thus dependent on common formats, new digitalized production tools (3D) and an internal intention to collaborate closely. This point to the conclusion that interventions at all levels are necessary if profound changes in the practice is to succeed.

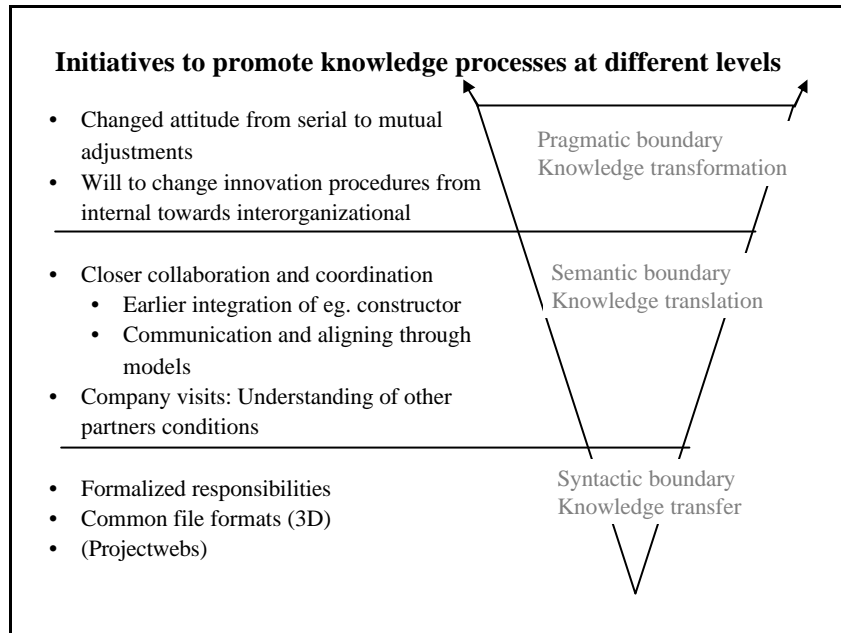


Figure 4. Initiatives followed in Ramboll to promote knowledge processes at different levels.

## Discussion and conclusion

Following from the analysis of the needs and the initiatives regarding inter-organizational collaboration in building projects, the biggest challenges seems to be the negotiation of interest into a shared approach to innovation. This is problematic due to the changing partners and the huge demands it places on changing internal practices to support inter-organizational innovations. These changes can be lengthy as both attitudes and long experience contribute to practices that may need to be transformed. The interventions from bips do not support this and the standards on fixed responsibilities might even work against it. Moving towards a closer interrelation comes with a change in attitude, rather than the following of initiatives such as shared financial initiatives. Instead the recommendation of creating a better understanding has been followed, which is hardly an initiative, but more of a recommendation. But it does happen not through opening up and gaining a broader perspective; it happens by a change in attitude stemming from the awareness that there is a need to do so. Economy still rules the world.

Another initiative or change could be use of strategic partnerships to build a closer working relationship with a small group of partners. This would provide the opportunity to take advantage of informally developed practices, trust and care that normally grows with personal relationships, and still keep the division between

consultants and constructors as requested by the insurance companies. A reason why this is not happening might be the need to compete and the importance of expertise.

The use of ICT seems to have importance at all three levels of knowledge processes; however, more at the level of transfer and translation than at the level of transformation. ICT is never a solution in itself, but it can be an essential part of the solution. ICT as a medium to exchange knowledge is essential, not least in distributed settings such as inter-organizational collaborations. It lowers the physical barriers to knowledge exchange, which is illustrated in the case of the bips standards. The use of web-technology provides the possibility of one central source that feels local; the standards are accessed directly from the Intranets in member companies through an external link. In this manner everybody has constant easy access to the same version of a standard. At the level of translation we saw how 3D tools help in translating knowledge across the different domains and create an understanding of how the different domains relate to one another.

The case of Ramboll illustrates that inter-organizational collaboration can happen at different levels from coordination to close interaction which is not the initial aim of Carlile. If the collaboration is seen as a serial relation rather than an integrated process the need for knowledge transformation in between organizations is reduced to a minimum, also less knowledge are needed reducing both the need for transfer and translation. But this is a matter a choice, if integration across the organizations succeeds which requires a lot of work at all three boundaries and not at least at the level of knowledge transformation this seem to promise for higher quality and lower prizes.

The discussion above thus provides insight to the transfer of Carlile's framework to the situation of inter-organizational collaboration as it shows that close collaboration is a strategic choice and not a main priority as within a company. In the case of inter-organizational collaboration it is questionable to the individual organization if close collaboration across the project is the overall goal or if more local innovations for future competition and qualifications are prioritized, or a balance in between.

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