



Integrated Design-Build Management 1.0

- A proposal for
change in the Danish
building industry

Integrated Design-Build Management 1.0

A summary of the industrial Ph.D. project *Integrated Design-Build Management – Studying Institutional Processes to Understand Project Coordination & Performance*.
Ph.D. dissertation, Chalmers Technical University, Sweden.

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Foreword – the context of the building industry

The Danish building industry is undergoing cultural change initiated by new digital tools and MT Højgaard's goal to increase productivity in the industry. The most important elements in this change process is early collaboration with project owners and the remaining project team as well as the use of Virtual Design and Construction [VDC].

At MT Højgaard VDC means that we are able to build virtually before we build 1:1 on site. Also, we actively participate in the early planning and design phases and that way we are able to assist in finding the most optimal solutions for a particular project.

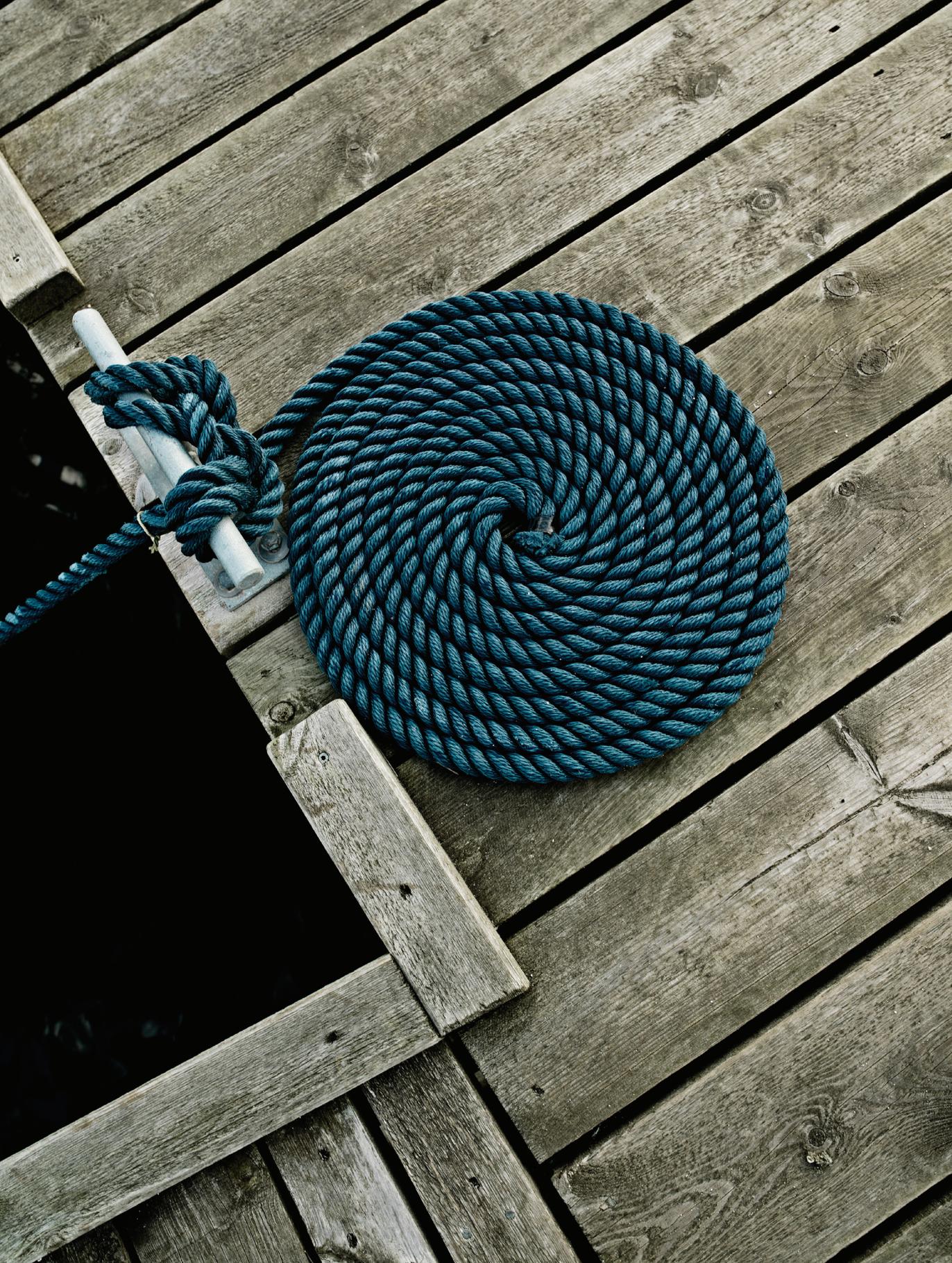
When we participate in the early planning and design phases we collaborate with the consultants and owner and contribute with early background analyses informing the siting, shaping, and programming of the building as well as construction logistics. During the design phases the use of VDC ensures that the project is modeled, simulated and optimized in relation to building logistics, economy and sustainability. Also, the virtual project enables the testing of multiple different solutions to ensure that the most optimal solutions are chosen for the final building. Once construction work on site begins, we also use digital tools increasingly to manage work on site and robot technology for site surveying, measuring and 3D scans. That way we can ensure that the project meets the agreed fiscal, time and quality targets.

In order to execute the virtual project we are dependent on information from architects, engineers, and owners, governing agencies, suppliers and installers. The large number of participants increases the complexity of collaborating and requires us to rethink the way we do projects.

The development of VDC in MT Højgaard highlights that previous collaboration processes, routines and norms don't support VDC optimally. Therefore, we are currently working on, analytically and strategically, creating new forms of collaboration in projects alongside implementing the digital tools.

The research project Integrated Design-Build Management is a relevant and interesting intellectual contribution to this development and supports many of the focus areas of MT Højgaard in connection to becoming the most productive organization in the building industry.

Torben Biilmann
CEO, MT Højgaard



Foreword – the context of academic research

Coordination has for a long time been the Achilles heel of building projects, organizations and the construction industry. Therefore, there is a need to better understand coordination mechanisms that lead to successful and less successful projects. In summary, that is what the industrial Ph.D. project presented in this publication researches.

MT Højgaard is an organization investing in industrial Ph.D. projects. Research aimed at organizations can support development and innovation. And often the candidate and her understanding and knowledge are the most important results. Chalmers Technical University continuously supports organizations to achieve such results. And the undersigned has had the pleasure of being main supervisor.

It is important, that society and organizations educate engineers that not only master current methods but also are able to shape the processes of the future.

An industrial Ph.D. is a piece of research. To conduct research concerns listening to, but also critically challenging practitioners and current practice. The starting point here was, that design-build projects have potential to improve, among others in regards to innovation. By applying institutional theory, the research project has been able to illuminate the processes of design-build projects. And the results show many opportunities for improvement and a number of specific recommendations for future work.

Thank you all who participated!

Enjoy.

Christian Koch

Professor, Dr.

Chalmers Technical University, Construction Management

Reading guide

This publication is intended to provide broad recommendations to project work in, in principle, all types of building projects, as well as across projects in the building industry. For that reason this publication is aimed broadly at project managers, contract managers, design managers representing consultants, contractors, owners, as well as politicians and leaders involved in changing the building industry.

In this first edition of Integrated Design-Build Management emphasis has been placed on describing the background of the research project and is presented in chapter 1. Subsequently the methods and results of the research project are presented in chapter 2. In other words, chapters 1 and 2 offer the reader insight into the research context of the project and are relatively extensive in this first edition. If, on the other hand, one wishes to gain insight into the Integrated Design-Build Management method, it is recommended to turn to chapter 3 in which a number of broad recommendations are presented. Similarly, chapter 4 is aimed at those wishing to implement Integrated Design-Build Management in practice today.

The Integrated Design-Build Management method is continuously being developed as experiences with the method in practice are gained and as research on design-build projects, new technologies, organization and management is developed.

Last but not least, the Ph.D. project is a personal piece of work and in that sense this publication contains my personal analyses, interpretations and judgments. As a result references are once in a while made to for example, ‘my’ judgments, conclusions and so on. Similarly, the ‘I’ of the publication is undersigned. The ‘we’ is the actors of the building industry broadly speaking.

Enjoy!

Lea Urup

Industrial Ph.D. student

MT Højgaard & Chalmers Technical University

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Chapter 1: Introduction



Why engage in integrated collaboration & project management?

In recent years the Danish building industry has focused on improving collaboration, among others, in building projects. This is partly due to increased requirements to energy performance, the use of BIM, and building owners increasingly wanting to optimize the final build and avoid conflicts and surprises along the way.

Increased collaboration among multiple actor further increase the need for coordinating actors' knowledge, competencies, cultural norms and well-established understandings of what constitutes a good project; what is important and right; and who should be doing what, when and why. The successful coordination of these social elements is the focus of integrated collaboration and the Integrated Design-Build Management method.

Integrated collaboration and design-build management is, simply put, all about creating new cultural understandings and norms for how we collaborate and deliver projects. The purpose is equally simple: integrated collaboration has the potential to increase both the social and technical coordination of projects and well as the quality of the final build. Therefore, integrated collaboration and Integrated Design-Build Management support MT Højgaard's vision to increase the productivity of the industry; ensure coherence between the interests of society and the quality of the final buildings; as well as being able to utilize competencies and synergies across organizations in the industry.

It is my impression, that MT Højgaard have always wanted to create projects that excited the owner and that MT Højgaard themselves were proud of. To achieve this, MT Højgaard have prioritized collaboration in practice and strived to coordinate the values of actors before projects begin. Furthermore, over the last three years, MT Højgaard have participated in a research project concerning collaboration and coordination of values, cultural understandings and norms.

This publication summarizes the key analyses and conclusions from a three-year industrial Ph.D. project (Urup, 2016) carried out in collaboration between MT Højgaard and Chalmers Technical University from June 2013 until June 2016. The research project concerns the analyses of six large design-build projects in MT Højgaard and answers specifically the following research questions:

How and why is social coordination enabled and constrained in design-build projects?

How does social coordination relate to project performance?

What constitutes a high performance project?

What would a management method that improves social coordination consist of?

By answering these questions the research project contributes to an increased insight in to

how a large Danish contractor succeeds, and occasionally fails, to integrate the values, interests, cultural understandings and norms represented in large design-build projects. Also, the research project proposes an integrated management method aimed at enabling individual organizations as well as across organizations in the industry to create shared goals and understandings, all for the purpose of increasing productivity in the industry and the quality of the final buildings.

Existing collaboration concepts

MT Højgaard aren't the first to pick an interest in collaboration. Around the world a number of concepts have been developed for the purpose of improving collaboration and the quality of buildings. Examples include integrated project delivery, partnering, building information modeling [BIM], VDC, integrated design, Trimbyg and LEAN. These concepts all propose to coordinate design and building processes and the involved actors through digital tools, collaboration processes or formal contracts. These concepts are to various degrees either diffused or not used at all in Denmark. The design-build method is the most common of the collaborative methods in Denmark and is becoming increasingly popular with contractors and owners because it is considered to increase control over and quality of the project.

Therefore, in an attempt to improve collaboration and coordination of Danish building projects in the future, the design-build project delivery method is the starting point for the industrial Ph.D. project. Furthermore, the Integrated Design-Build Management method is inspired by integrated project delivery and partnering and is aimed at creating an overall method for leading and managing projects without prescribing a specific contractual framework. Similarly, the use of integrated design, VDC and BIM are recommended in the use of Integrated Design-Build Management, as these concepts are mutually supportive. This will be elaborated shortly.

Existing research on coordination

Existing research concerning coordination in the building industry emphasize the uniqueness of projects. Because projects are interpreted to be unique, the focus of coordination becomes handling unforeseen events, risks, uncertainties and the on going planning of schedules and activities. As a result, management becomes a matter of making people follow certain plans, meet certain deadlines and carry out certain activities in certain orders.

As long as projects are interpreted as unique sub-optimizing each project comes to the fore, while optimizing across a portfolio of projects is neglected. As a result the organizations in the bundling industry are unable to create and utilize the insights that come from understanding how project relate over time.

Furthermore, in conjunction with interpreting projects as unique, there is an understanding

that if only time schedules are sufficiently accurate and all risks are identified, actor will attempt to act rationally and follow the schedule and avoid risks. But the point is, that human beings don't act mechanically or unilaterally. On the contrary, when multiple actors collaborate the project becomes an arena for multiple interests and understanding of what is right and important for the project. These socially well-established understandings of what is right and important for a particular project is something that the actors in the organization and industry have built up over time project after project. As a result, projects follow particular patterns and produce the same types of success and lack of success, as opposed to being unique.

Why consider the cultural understandings and norms in projects?

The starting point for integrated management and collaboration is the understanding that building projects are indeed similar. That means, projects typically follow the same phases; involve particular actors at particular points in time; concerns the same type of information requiring coordination; are based on the same standards, contracts and agreements; represent particular understandings of what is right and important; and typically reproduce the same successes and conflicts over and over.

Because projects are similar, the organizations in the building industry have gradually developed well-established or even taken-for-granted cultural understandings of what constitutes a good and right design-build project and how the project is supposed to develop. Examples of taken-for-granted cultural understandings in design-build projects include: the contractor and consultants are supposed to collaborate; the architect is responsible for developing a conceptual design, while the contractor is responsible for developing the detailed design project; and, that finishing the design project means handing off a set of drawings. Notions such as collaboration, conceptual design, and detailed design are all social constructions that we have created over time and supported by for example standards, norms, agreements, fee structures, service descriptions and thus we have ended up understanding it to be right and important, and perhaps even natural and the only possible way to do a design-build project. Our understandings of what is right and important very much guide the way we interact, because when we enact what is commonly accepted as the right and important we appear socially well-adjusted and professionally competent. Furthermore, it eases our work because it frees us from constantly reflecting upon what we do, but instead allows us to tap into generally accepted ways of acting and interacting.

On the other hand, individual organization have also developed different understandings of what is right and important for a particular project because different organizations represent different professions, have different values and so on. Similarly there is also room for change and innovation. When listening to and speaking with project team members and managers in the different organizations in the industry is it clear that many critically reflect over these challenges on a daily basis and bring new ideas and improvements to the projects and their respective organizations. These improvements may relate to the way we speak to each other

in order to, for example, make us more oriented towards problem solving. Improvements may also concerns formalizing processes through standards and legislation; increase the use of digital tools; tell new stories that support new cultural understandings; or initiating early collaboration and functional tender. Many of these improvements are inspired by previous projects, trends in the industry, as well as the individual actors' experiences and professional background. In other words, the projects, as well as the development of projects, follow particular patterns. These patterns are the result of critically thinking and (inter-)acting individuals, lessons learned from previous projects and our more-or-less taken-for-granted understandings of what is right and important for a particular project.

By creating insight into what cultural understandings and norms we create in building projects and how these understandings relate to each other we also gain insight into why we reproduce the same problems and successes project after project. That way, we gain a deeper understanding of the problems and successes we encounter and collectively we can change current cultural understandings or create new understandings, if it improves collaboration and the quality of projects. Furthermore, we can maintain or further support existing cultural understanding if they are interpreted to support collaboration and project quality. All in all, the insight into the dynamics between cultural understandings in projects is a promising starting point for enabling more success and avoiding particular problems in the future.



Chapter 2: The foundation and results of the research project



The building project as a mutating constellation of understandings

Building projects constitutes a constellation of norms and cultural understandings. The means, during the project we develop multiple norms and cultural understanding that relate to each other. Sometimes particular understandings dominate others, at other points in time the understandings contrast and potentially even conflict each other. A conflict means, that it is not possible to satisfy both understandings through unified action. This is what we typically experience when we sense that collaboration is constrained in our projects. Previously, within MT Højgaard there has not been a vocabulary to describe these types of collaboration problems and instead we have developed partial or approximated explanations as to why collaboration is constrained. An approximated explanation for poor collaboration could be for example, that the other actors lack insight and competencies, that the industry is characterized by lack of professional empathy, or perhaps even, that the others are idiots. Integrated management would, instead, regard most problems pertaining to collaboration as a matter of actors having different understandings of who should do what, when, how and what is right and important for a particular project.

How was the Integrated Design-Build Management method developed?

The Integrated Design-Build Management method is the result of a three-year long research project. The research project has been divided into two parts: an analysis part that provides insight into how coordination is enabled and constrained in design-build projects; and a proposal for a new management method. The analysis is based on one large on-going and five completed design-build projects, while the new management method is based on the results of the analysis as well as literature on collaborative project delivery methods and project management methods, including VDC, integrated project delivery, partnering, target value design, and integrated design.

The research project has used qualitative methods to obtain a deep and nuanced insight into the norms and cultural understandings that are developed in design-build projects.

In practice, interviews, observations, collection of documents and site visits have been conducted. In total, 37 project managers, leaders, design managers, process managers and BIM coordinators across MT Højgaard, architectural and engineering consultants and owners have been involved.

The research method is based on interpretation. In other words, the empirical material has been critically interpreted within the theoretical frame that describes the interplay between the cultural understandings and the actors. Interpretation has occurred through critical reflection of the empirical material in conjunction with the theory, whereby insights have emerged as flashes of immediate knowledge in the brain. These insights have subsequently been written down, re-read and mapped in order to find emerging patterns. The results of these interpreta-

tions are presented in the analysis.

Last but not least, critical reflection has been used to develop the integrated management method. That means, the insights from the analysis have been critically interpreted in relation to how particular coordination processes may support the strategies and visions of MT Højgaard concerning increased productivity and best in Class VDC. The integrated management method is also inspired by collaboration concepts such as VDC, integrated project delivery, partnering and process methods and tools such as LEAN, integrated design, Trimbyg, target value design, knot-working, pull-scheduling and BIM.

What characterizes current collaboration?

Overall, the analysis of the research project shows that all actors in principle want to collaborate and that several efforts are made within the projects and the respective organizations to enable collaboration. There are several examples of project kick-off meetings with early establishing of expectations, partners selected based on trust and competencies over price, social events intended to knit together the project team, joint project offices, close dialogue between consultants, owners and contractors – just to mention a few.

Although everybody wants to collaborate, often the different organizations in the team start working in different directions because they have to fulfill conflicting economic, juridical and political goals. These goals can be more-or-less obvious, but often we do not discuss how we resolve working towards these conflicting interests in a project or in the industry more broadly.

Apart from the economic, juridical and political goals, the different organizations also have to satisfy a number of more or less taken-for-granted cultural understandings and norms, that we collectively have established in our society, the building industry, within each organization, individual departments and even projects. As mentioned previously, the cultural understandings guide how we believe a particular project should progress, who should do what and when, what is right, legitimate and important for a particular project. Specific examples include taken-for-granted understandings of what areas of responsibility belong with the contractor; how true architects priorities; what phases a project should be divided into; when it is appropriate to involve a supplier; and many more. These understandings arise from previous experience and the way we usually do things. Therefore the social norms and understandings are often enforced and maintained collectively as we begin to collaborate in our projects. A lot of the norms and understandings we have developed support what may be considered basic project goals, for example, that we want the projects to be efficient, economically viable and result in a minimum of quality.

Unfortunately, several of the norms and understandings do not support collaboration, but instead fragment the actors and project work as the project progresses. Often, we are not aware, that it is our different and potentially conflicting understanding of what is right and

important for the project, that fragments the project organization. The fragmentation typically manifests itself by project team members becoming frustrated with each other and thinking the others are idiots unable to understand how the project is supposed to be executed. Even in this situation we may still believe collaboration is going well because we simply have come to expect that project team members counteract each other. But a key point here is, that early frustration indicates a potentially growing fragmentation of the different norms and understandings in the project – a fragmentation that can result in significant conflicts, rework and ultimately poor quality of the final build.

Currently, it is not common practice to collectively discuss, reflect upon or evaluate the social fragmentation to avoid conflicts in projects. As mentioned previously, shared expectations are often established in the early project phases, and these are a first step towards discussing, reflecting upon and evaluating collaboration. However, it is important to emphasize, that our expectations may be guided by social norms and that expectations also develop over the course of the project. Therefore, it is important that the industry, individual organizations and projects increasingly focus on discussing, reflecting, evaluating and developing integrated ways of collaborating over the course of a project.

At MT Højgaard critical discussion, reflection and evaluation of previous collaboration and ways for improved collaboration in the future is underway. Initiatives such as VDC, the use of BIM, key client program, close dialog with consultants and suppliers are all examples of how MT Højgaard are working towards changing their understanding of collaboration. And this is a key point, that the cultural understandings are indeed social constructions and something that we collectively create and can change, if we want to.

The following section summarizes the analysis of the research project and how relationships between several taken-for-granted understandings respectively enable and constrain coordination in design-build projects. The analysis is divided into two parts: the first part describes the results of the analysis of the on-going design-build project and illuminates how coordination of cultural understandings and norms are respectively enabled or constrained; the second part describes the results from the analysis of the completed projects and illuminates the relationship between coordination of the cultural understandings and the projects' final performance.

Well-established understandings and design-build projects

The in-depth study of the on-going design-build project shows that a number of particular understandings of what constitute for example quality, collaboration, efficiency, economy, coordination and management develop over the course of the project.

Quality

The notion of quality has a range of interpretations among project actors and include an understanding of functionality, aesthetics, constructability, phenomenology, and getting the most building for the money invested. In other words, when project actors claim a project to be of high quality, it can mean many different things. And although project actors are interested in incorporating as many qualities in the project as possible, each profession has developed different cultural understandings of what constitutes quality in their particular field or organization. To the architects, quality is primarily a matter of materiality, durability, functionality, aesthetics and phenomenology, although they are also interested in keeping the project within budget. To the engineers, quality is predominantly understood as functionality, efficiency and the durability of a particular technical solution, although these include understandings of aesthetics and economy as well. To the contractor quality is primarily understood as the integration of economy, time and durability of materials, although areas such as safety, aesthetics and functionality are also represented in their notion of quality. To the project owners quality is typically a notion that encompass both the architects, engineers, contractors and potential investors and client's normative understandings.

Collaboration

Similarly, there are multiple understandings of the notion collaboration. In some projects and organizations collaboration is interpreted as a matter of respecting formal organizational hierarchies and normative areas of responsibility. To coordinate a project within such an understanding actors are required to share strong common understanding of what each area of responsibility encompass and when each actor is expected to delivery parts of a project and why.

A different interpretation of collaboration include the understanding that actors need to be pragmatic and interact in regards to what is best for the progress and quality of the project. This understanding includes actors acting relatively free of formal hierarchies and express ideas and critique in an open, respectful and trusting environment where formal procedures, standards, normative responsibilities, stereotypes and hierarchies are secondary. The requisite for coordinating according to this understanding of collaboration is on-going communication.

Economy

In projects there are typically two different understandings of the notion economy: either economy is understood as a wide and long-term optimization and gains without compromising other interests in the project; or economy is interpreted as a matter of making the most money in the short-run regardless of long-term effects on remaining project interests and future collaboration.

Efficiency

The notion of efficiency is understood as carrying out a particular process without rework. During the design phase efficiency is typically interpreted as a matter of avoiding re-designing and freezing particular parts of the projects in order to avoid rework and late changes to the project. During the building phase the notion of efficiency is understood as both a matter of avoiding rework on site as well as the building process progressing without interruptions and delays.

Coordination

The notion of coordination is associated with both the understanding that coordination is a discipline that requires management, as well as coordination being a matter of technically coordination for example building components, activities, time and deliveries. Managing for the purpose of coordinating is understood as primarily a matter of applying formal structural mechanisms such as contracts, organizational hierarchies, and economic punishment and reward to achieve the desired interaction and project outcome.

The other understanding of coordination is associated with the constructability of projects and the progress of the building process. In this case, coordination is predominantly interpreted as a technical discipline where coordination of for example building components, activities, schedules and deliveries dominate.

The development of understandings during design and build processes

The understandings associated with quality, collaboration, economy, efficiency and coordination and their interplay develop over the course of a project.

In the beginning of the project, typically during the early analysis and programming phases all actors agree that collaboration is the right thing to do, and that quality, time and economy

are all important. Nor do we question that the project needs to be managed or coordinated. In some projects we carry out early matching of expectations, interviews, kick-off workshops, collaboration agreements that describe qualitative values, target costs and potential incentive agreements that are intended to support collaboration. The formal organizational hierarchy is also typically determined at this point in the process and the actors take on their roles and the project begins. From this point onwards collaboration follows relatively well-established patterns – even in the cases where the contractor is involved early.

As the design phases progress we begin to develop well-established understandings and patterns of interaction. For example, we share an understanding that project work is to be coordinated at management level which is supported by the planning of management meetings where coordination is intended to occur. In some cases we also establish project offices supporting the idea that coordination happens spontaneously and across organizations and organizational hierarchies. Other well-established understandings and patterns of interaction are associated with the distribution of responsibility of the work. For example, the contractor is understood to defend and maintain the budget and constructability, while for example the architects are understood to defend and maintain aesthetic, phenomenological and functional interests, and the owner is understood to be responsible for making decisions. A third and important understanding concerns the design process being developed through a number of phases each associated with the delivery of for example a preliminary and a main design project, as well as notions such as deadlines, deliveries and sanctions.

These understandings and patterns of collaboration are supported by our collaboration agreements, consultant agreements, ICT-agreement and so on and therefore further reinforce well-established patterns of collaboration.

As mentioned previously, project team members are usually able to match their expectations and establish common rules for collaboration during the early project phases. However, although we may sense that collaboration is going well, the analysis shows that our understandings of what is right and important for a project gradually begin to fragment. This comes to the fore when we reach the hand-in of the preliminary design project and the transition into the detailed design phase. At the transition to detailed design phase the contractor often has an understanding that they are to take over project responsibility (which is often also supported by formal agreements). This implicitly means, that the contractor's normative interests of budget and constructability are understood to dominate the project and guide the remaining actors' thinking and planning in the same way that the contractor has accepted that it was the architect's values and interests that dominated the project during the early design phases.

However, at the transition from basic to detailed design the project is far from completed (it is after all just a preliminary project). Therefore, the owner and consultants (and the contractor) expects the team to continue work on the quality of the project (aesthetics, functionality, phenomenology, cost optimization and so on) during the detailed design phase.

And this presents an inherent conflict: on the one hand the intent to coordinate the project team's work based on a building logistics and constructability logic; and on the other hand, the intent to coordinate the project team's work based on the understanding that is right and

important to continuously increase the quality and finish the project. These contradicting understandings result in numerous contradicting workflows, that slow down the progress of the design work, results in reword of the design, and worst case, means that certain qualities are not included in the project at all.

Another example of different well-established understandings include, on the one hand, the understanding that the hand-in of a fully coordinated and constructible project before construction begins is essential for the success of the project; and, on the other hand, the understanding that is more important for interaction to be flexible and that the hand-in of the main project can be postponed. Other examples include, that within the contractor's organization there isn't a shared understanding of whether or not it is right and important to accept late changes. On the one hand, the contractor would like to be service-minded and increase the scope of the project (assuming that the contractor is paid) and on the other hand, the contractor would like to reject changes in order to finish a detailed design and increase efficiency of the construction process. Also, project managers don't seem to have a shared understanding of whether management is a matter of being tough or display empathy.

The result of all these contradicting understandings is, that management is always required to act ambivalent to satisfy multiple understandings of what is right and important. Worst case, management is paralyzed and become victims of the process they were indeed intended to manage. In practice, ambivalence and paralysis manifest itself as frustrations on a daily basis because it becomes difficult for all project team members to get a sense of the purpose of the their daily work and because work is wasted and has to be redone. In the long run the result is poor quality of the design project that results in further rework and poor quality of work during the building process.

During the building process the project team typically accepts that the contractor becomes the dominating actor and thereby the interests that the contractor normatively represents become dominating too. In many cases the contractor makes an effort to include the consultants during the building process so the interests and responsibilities pertaining to the consultants are maintained in the project. However, when the building process begins most actors adapt to the flow of the building phase. Nevertheless, the contractor continuously has to adjust the design project, deliveries of materials, equipment, work crews and the time schedule to continuously keep production going.

The in-depth study also shows that the organizations participating in the projects and individual project team members reflect upon and make efforts to enable collaboration. Unfortunately, these efforts are often characterized by organizations trying to make their own understanding of what is right and important dominate. More specifically, the majority of the contractor's efforts are aimed at making the other organizations accept that it is indeed budget and constructability that should structure work during the detailed design phase. Similarly, the owner may argue and justify why late changes to the project are acceptable, because it may increase functionality of the final building. However, when everyone makes efforts to dominate, it will be the power or persistence of a particular actor that determines what understandings

dominate the project.

In connection to reflexivity, the analysis also shows, that organizations make efforts to coordinate values, expectations, understandings, processes and interests in the early project phases and that there is an understanding, that economic incentives and contractual agreements more or less single handedly can create the intended behavior in the project team and outcome of the project. However, the analysis shows, that organizations become decreasingly reflexive as the project progresses and that well-established understandings are increasingly produced instead. This is due to, among others, the understanding of what is right and important and expectations changing over the course of the project from one project phase to another. To that, management is characterized by actors representing particular sets of interests and understandings while none of the actors are normatively responsible for ensuring the integration of all the interests and understandings represented in the project. Specifically this means, that when for example the contractor takes on responsibility for the detailed design phase the contractor and the remaining project team understands this to mean that budget and constructability is formally to guide project work, not that the contractor is responsible for integrating aesthetics, functionality, budgets, constructability, efficiency and many others. The result is wasted work, contradicting work, lack of work, and processes that slow down, stall or re-circuit during design and construction processes.

On the other hand, the project team succeeds in coordinating the project when the cultural understandings are integrated. A specific example of this includes the project team agreeing that including for example a façade supplier in the basic design phase is right and important and, in collaboration with the façade supplier, creates a design process that enables the development of a façade that is aesthetically pleasing, has the right color, support the required indoor climate, can withstand the wind pressures, meet required energy performance, meet owner's requirements for maintenance, fits the concrete structure upon which it is installed, can be installed efficiently and without compromising safety, and costs what the owner is willing to pay. In such a case the project organization has to rethink well-established patterns of collaboration by for example inviting a façade supplier to participate early and actively in the design process; priorities to carry out joint production site visits to create a shared understanding of what the façade will look like and why it costs what it costs: and, dissolve organizational boundaries to create a shared inter-organizational process.

An important point regarding integrated collaboration is, that actors are able to optimize the project within each of the relatively narrow areas of interests and responsibilities typically represented by each profession, while also being able to create the necessary shared understandings and a shared process where all interested can be integrated. Therefore, integration is not a matter of blending and all sharing common interests, but rather creating shared as well as maintaining certain distinct interests and enabling integration rather than seeking domination of particular interests and understandings. In other words, successful collaboration is characterized by shared excitement and progress, as well as a certain diversity and disagreement.

The relationship between coordination and project performance

The study of the 5 completed design-build project identifies relationships between project coordination during the design and building phases and the projects' final performance. Overall, the analysis shows that the relationship between different cultural understandings during the design and building phases are reflected in the final building. More specifically, for example, if the design and building phases are characterized by the understanding that short term economic gains are worth pursuing and dominate the work of the project team, the final build will (perhaps) have achieved some economic gains, while other areas such as quality of materials, spatial quality, indoor climate, sustainability and so on have been compromised. The dominance of a particular understanding may not necessarily represent an unhappy compromised but rather a deliberate choice. In other cases, the dominance of a particular understanding is the result of a battle for influence where particular understandings end up dominating due to actor's power or persistence. In such cases the project team members will typically express frustration with the areas that were compromised in the project and anecdotes of poor collaboration will follow.

If the design and building phases have been characterized by conflict and competition among understandings, the final building will also reflect that a particular understanding, won the competition, so to speak. An example of this may include a building that looks architecturally well designed and functionally operates satisfyingly, but where the contractor has made no profit. In such case it can be argued, that the understanding that quality was most important won over the understanding that all project team members need to make a profit. In other words, the project's final performance becomes a snapshot representation of the power struggle that unfolded during the design and building phases.

If the design and building phases are characterized by integration project performance will also reflect integration. Since all projects in MT Højgaard have resulted in a finished building that was occupied at some point, it can be argued, that all projects achieves at least a minimum of integration. Examples of full integration include the project team succeeding in creating a solution in which the interests of the architects, the engineers, the owners, the contractors, the suppliers, the workmen and so on are satisfied. This requires close collaboration with and detailed understanding of the respective actors in order for the project team to develop a shared process and shared understanding as opposed to developing different processes driven by different diverging understandings.

In other case partial integration is also observed. A typical example of partial integration concerns the lack of functioning ventilation and indoor climate in buildings that otherwise succeed in integrating spatial flows, aesthetics, budget, time and so on. This is interpreted to be the result of ventilation and indoor climate being relatively complex technical issues to resolve on large building projects and that the actors dominating the design phase simply fail to sufficiently priorities to integrate the understandings and knowledge required to ensure a satisfying indoor climate. In other words, there is no norm for the indoor climate consultant to dominate the project team or be assigned the responsibility of design management and this is reflected in the projects' final performance.

Chapter 3: The Integrated Design-Build Management method



Integrated Design-Build Management – a menu of recommendations for current and future projects

Based on the analyses of current collaboration and project performance, the research project further proposes a method for managing large design-build projects. This method I call Integrated Design-Build Management.

It is important to emphasize that Integrated Design-Build Management is a method aimed at establishing integrated management and collaboration, and not a project delivery model. The integrated project is characterized by integration among all interests intended to be represented in the final building. Therefore, the integrated management method concerns creating cultural understandings and constellations of understandings, norms, processes and rules that enables the integration of as many interests as possible. The purpose of the integrated Design-Build Management method is to enable project organization to create that particular constellation of understandings, norms, processes and agreements that is most conducive to achieving the project's goal.

At the heart of Integrated Design-Build Management is collective and critical reflection of which cultural understandings, norms (processes & tools), and rules (written and unwritten rules) are to guide a particular project as well as how these three parts (cultural understandings, processes and rules) interrelate.

In the following sections a more detailed description of the integrated management method is presented as well as a number of specific recommendations to how project organizations can improve collaboration and coordination of projects.

Recommendation 1 – Reinterpret leadership

As mentioned previously, the purpose of the Integrated Design-Build Management method is to create projects that succeeds in integrating as many interests as possible by creating shared understandings, processes and rules.

Integrated management concerns critically analyzing, evaluating and either changing or maintaining existing cultural understandings, norms and rules. In some cases, current understandings already support integrated collaboration (for example, the growing understanding that early collaboration is important for coordination) in which case the foremost task of the management team is to maintain or perhaps even further strengthen this particular understanding. Cultural maintenance work can be done at multiple levels, through for example larger organizational strategies and partnerships, political work and education of key actors, change of tender procedures and using rhetoric to create greater legitimacy around early collaboration.

In some cases it may be more conducive to change or eliminate particular understandings that constrain integrated collaboration (for example, the understanding that one should not interfere with the work of others for fear of being held responsible later, even if the process is not progressing or the quality of work is dissatisfying). Change and elimination work can occur through creating doubt about the rightness and importance of the understandings one wishes to change or eliminate. Specifically, one could articulate that not interfering with the work of others if the project is running off track is morally and professionally irresponsible.

Apart from maintaining, reinforcing, eliminating, and changing existing understandings it may also be fruitful to create new understandings, for example, that the use of BIM and VDC is right and important. Creation work includes creating legitimacy and moral acceptance of the new understandings of what is right and important in each project. For example, by emphasizing that a thorough and analytical approach to pre-construction design and planning is right and important, the use of BIM and VDC can be legitimized as these tools and process models support technical coordination and enable the testing of multiple scenarios during the design process.

In summary, integrated management concerns disruption, maintenance and creation of shared cultural understandings, processes and rules as well as of the interplay among these. In practice, integrated management involves a wide range of tasks from broader societal and political work; strategic partnerships; everyday routines and processes in specific organizations and projects; standardization, legislation and agreements; the use of new technology; the rhetoric that organizations use to describe themselves as well as those whom they collaborate with; the story and jokes we tell on a daily basis - all of which support the cultural understandings we create.

Such a wide range of tasks requires the outmost critical awareness of managers and leaders. It requires that we critically reflect upon how both major and minor everyday actions and interactions either enable or constrain integrated collaboration and integrated projects. On the other hand, management and leadership work becomes a collective responsibility as cultural understandings, norms, and rules are abstractions we create and choose to enact collectively.

Several definitions of leadership and management are based on psychological discourses, where leadership is interpreted to concern the individual leader and her ability to understand herself; how to make others follow; how to motivate others, and so on. With integrated management focus is shifted from the individual leader's self to the collective efforts that are made among leaders and project organizations to disrupt, maintain or create existing understandings, norms and rules. Integrated management concerns exercising collective courage and will to create new cultural understandings, norms and rules for how we collaborate and deliver projects in ways that increase the productivity of the construction industry, increase quality of the final buildings and increase satisfaction of the users of the buildings.

Recommendation 2 – Separate the design and build phases

Many people consider the overlap between the design and build processes one of the important advantages of the design-build method, because it is interpreted to shorten the duration of the entire process. Another advantage of overlapping the design and build processes is, that it enables the consultants and the contractor to collaborate to finish the details of the project. However, the overlap does present some challenges, for example, it supports the understanding that design coordination issues can be postponed until the build phase, which can result in rework and poor efficiency of the building process. Furthermore, the overlap reduces the opportunities to integrate all the design solutions of the project and therefore reduce the potential for optimization of the project.

By separating the design and build processes we can enable better planning and virtual modeling of the project before the build begins on site. A separation of the two phases will also enable testing multiple design scenarios virtually and enable integration among the different interests before the project is constructed. There are two parts to this recommendation: the first part concerns creating the shared understanding that it is right and important to fully coordinate, model and finish the detailed design before it is constructed on site. The second part concerns the temporal separation of the two phases. Both parts require that we disrupt the understandings concerning being able to shorten the duration of the process by overlapping the design and build phases; that it is important to start construction as soon as possible; and that it is not cost effective to fully model a project. With Integrated Design-Build Management three different understandings are created: that it is possible to reduce time and cost through due planning and coordination during the design process; that it is important and right to wait with the construction process until we know exactly what and how a particular project is to be built; and that a project should be fully modeled.

This recommendation is linked to the increasing digitalization and atomization in the building industry. As the digital competencies of actors in the fields increase, the use of BIM and VDC will gradually become more established. Gradually, quantity take-offs, collision controls, simulations of building logistic scenarios, simulation of multiple design scenarios and rapid cost calculations, sun and wind studies, just to mention a few, will be perceived as a natural part of our every day work. As the use of digital working methods increase, the design process can similarly be made increasingly efficient; we can change the organizational structures of our projects accordingly; and, we can create a shared understanding that the design process is an analytical and systematic creative process resulting in a finished project model. Similarly, the building processes would gradually become more efficient and increasingly become automated as technology replace human beings in tasks we today can't imagine being done by others than human beings.

Recommendation 3 – Develop integrated phase models and design by theme

Integrated Design-Build Management also recommends, in conjunction with separating the design and build processes, that the project organizations develop a shared understanding, that rework doesn't have to be a result of inefficient design processes, but rather can be deliberately planned as an iterative design process, in which multiple interests and professions are integrated. Normatively, the design process could be planned as a series of themed design sprints, ensuring that the project is designed, detailed and coordinated in its entirety multiple times before construction begins. The use of BIM and VDC provide tools and structures that enable rapid and smooth iteration processes and the systematic iterative themed design process is referred to as the integrated phase model.

The integrated phase model consists of a number of systematically pre-defined themed design sprints lasting 1-2 weeks each. The design sprints are planned according to dependencies of design information, as opposed to, for example, professional value chain. When a number of design sprints have been completed and the project worked through once, the project enters the first gate where the project is systematically evaluated and further progression of the project is planned. To ensure the technical coordination of the project as well as to ensure that all interests are integrated in the project, series of design sprints are repeated until the project has been worked through a number of times.

Integrated Design-Build Management does not in detail suggest the specific setup of the integrated phase model. The point is; Integrated Design-Build Management recommends a phase model that is intended to integrate multiple interests, as opposed to a phase model that allows interests to dominate in turn. With the integrated phase model the design process is interpreted as a series of intense, design sprints planned around specific themes and only requiring few and particular competencies and resources. This also means, that the project organization as we know it today with large organizations collaborating full time over potentially several years, can be radically changed. With an increased use of digital tools during the design process, the design development process can be shortened and design evaluation can be increasingly analytical and used to systematically progress the project. Similarly, the project can be interpreted as an abstraction that travel from one group of competencies to another, as opposed to embodied in a large organization and growing from a largely muddled process.

To this end, the understanding that design develops from concept to detail may be fruitfully changed to an understanding, that design develops simultaneously in both detail and concept. Early collaboration with product suppliers, the use of BIM and access to digital product libraries enables early considerations of detailed design solutions and interfaces. All in all, this means that process models and collaboration agreements that reflect more efficient, systematic and integrating design processes can replace the phase models and service descriptions we use today.

Recommendation 4 – Define collaboration and coordination in projects

In practice, when we talk about and go about collaborating and coordinating, our understandings of two notions are overlapping. Currently, collaboration predominantly concerns psychological elements, for example focus on personal profiles and the so-called soft aspects of interacting. However, the notion of collaboration can be expanded to also include the understanding that collaboration require coordination of cultural understandings, norms and rules. Similarly, coordination is currently predominantly interpreted to be a technical matter including for example, planning of activities and schedules, and technical coordination of building components. Apart from efficient planning of activities and schedules, coordination also concerns standardization of processes, products and competencies, as well as how actors collaborate on a particular project. Coordination from a collaboration perspective includes communication; making an effort to understand the perspectives of others, their professional cultural background, their business interests; taking responsibility for the project as a whole; working towards a shared goal; adapting to the interests and understandings of other project team members; and collectively trying to create a project culture that enables access to and use of the right competencies.

Successful collaboration (i.e. collaboration that results in coordination) is characterized by actors being able to openly share and develop ideas and critique; that actors freely interfere with the work of other for the sake of improving the project; and that there is open and articulated reflection regarding the potentially contradicting goals, interests, cultural understandings, processes and rules represented in the project.

With Integrated Design-Build Management the project team continuously defines and evaluates the quality of the collaboration and coordination. Currently, often collaboration agreements describe the mechanisms we wish to use to coordinate project work. We should continue this development and become even better at analyzing what cultural understandings, processes, norms and rules we can create, maintain and disrupt. To that, it would be fruitful to make a habit of continuously evaluating collaboration and whether a particular project's understandings, processes and rules actually support the intended collaboration and coordination. Currently, these types of evaluations are not common practice. However, if legitimacy around focusing and allocating resources to improving collaboration and coordination could be established, on-going evaluation could become common practice. Furthermore, collaboration is, due to its psychological orientation, often considered a very personal matter that team members avoid addressing and find uncomfortable to discuss. However, creating an understanding of collaboration that increasingly focuses on cultural understandings, interests, values, norms, and rules reduces the individual aspect of collaboration and thus makes it less uncomfortable to collectively discuss and evaluate.

Recommendation 5 – Continuously develop and evaluate goals for project and process

In the same way that management and leadership can be defined as matter of creating, maintaining or disrupting current cultural understandings, project performance can be defined as a reflection of how well we succeeded in coordinating the multiple cultural understandings in a particular project. Therefore, typical success criteria such as, the number of errors and deficiencies, fiscal and time schedule targets do not characterize the good project. Rather, the good project is defined as a project in which the project team has enabled the integration and satisfaction of all the different interests represented in the project (including potential economic, quality and temporal interests).

Integrated Design-Build management also includes a recommendation that project organizations actively and deliberately evaluate the progress and quality of both the project and the process. The respective project organizations can develop specific targets for both the project and the process that are then evaluated once in a while. As mentioned previously, the project organization would have to allocate time and space for a collective discussion of how the cultural understandings in a given project have developed and should develop onwards: are our understandings fragmenting our work efforts and can we foreseen future problems and conflicts? Are our cultural understandings too aligned and even blended to the point where we forget to critically access the work and efforts of others and ourselves? Or, are we successfully integrating our understandings and enabling an optimized project that, once build and occupied, will satisfy the different interested represented in the project?

Recommendation 6 – Reinterpret BIM as a social tool

The last recommendation is specifically tied to the understanding of the digital tools used for BIM and VDC. BIM and VDC are currently primarily understood as digital tools that offer technical possibilities and have to fit our current work processes. However, Integrated Design-Build Management recommends that the digital tools be interpreted as social tools that can inspire new ways of collaborating across traditional organizational boundaries. In other words, the digital tools can be used to create new work methods and new ways of collaborating. For example, a BIM review session can be used as an occasion for creating shared understandings of both the technical challenges in the project, as well as how the project team can take collective responsibility to resolve BIM related issues across organizational boundaries rather than pointing to the mistakes made by others. Similarly, the project team can consider whether professional boundaries are to determine the use of for example, an architectural model, an installation model and a structural model, or whether the BIM platform could be used to soften the professional boundaries.

A third example includes how BIM models offer potentially much more detailed design material than 2D drawings, let alone conceptual sketches. This means, that BIM offers an opportunity to work with detailed design information during the early design phases which in

return means, that we may consider to begin a project with the detail and interfaces rather than the concept and major building systems, as well as how sub-contractors and suppliers may be able to contribute to the modeling and design process. Similarly, the digital tools can assist Urban VDC analyses that in return can facilitate the contractor's access to early project work and support the understanding that it is right and important to thoroughly plan the project before construction begins. Also, as previously mentioned, the use of digital tools can support a much more iterative design process where different design scenarios are simulated and evaluated in terms of for example building logistics and project cost. This also suggest, that we reinterpret our understanding of project changes: whether project changes are to be avoided, the work of the devil, an opportunity to increase project scope; or, whether project changes can be planned as part of the early design phases to enabled informed decision making. Similarly, engineering consultants can be inspired to use the digital tools in a way that supports an inter-organizational and iterative design process in which intuitive, analytical and systematic processes are at the core of the design development, in order to ensure an integrated finished building at the end of the construction phase.

Chapter 4: Getting started with Integrated Design-Build Management



The role of the contractor in Integrated Design-Build Management

As previously mentioned this publication is aimed at professionals in the building industry involved in management and change processes. The Integrated Design-Build Management concept introduced in the previous section is not exclusive to the contractor, but rather a management method that can be used by, in principle, all organizations in the building industry. If we collectively aim to create better buildings and increase the productivity of the industry, it is important that organizations and each project's management team take responsibility to create particular constellations of cultural understanding to ensure that the final building reflect a deliberate integration among multiple interests and professions. In those cases where MT Højgaard carry that responsibility, the contractor would not only be responsible for meeting project cost and constructability targets, but rather be responsible for integrating all the understanding, values and interests that the owner wants represented in the final build, for example, aesthetics, functionality, facility management, sustainability and so on. This means that the project team accepts responsibility to integrate the project with the project owner from the early design and planning phases.

Requisites for Integrated Design-Build Management

The Integrated Design-Build Management method can be implemented on any project. Although the research project focused on design-build projects, integrated collaboration and management can be exercised on other project delivery methods – and even reaches beyond the project level, in the case of for example, strategic partnerships established across organizations. In conjunction with the recommendation for separate design and build phases, the Integrated Design-Build Management method is particularly suited for design-bid-build projects where for example, the contractor could participate as a consultant equal to the architect and engineer. Functional tender, integrated project delivery and partnering are other examples of highly collaborative project methods that can utilize Integrated Design-Build Management recommendations.

Implementation of Integrated Design-Build Management – Questions & Assistance

The adaption of Integrated Design-Build Management to each project and organization is an on-going and collective effort from this point onwards and I'm available to assist and advise as required. For example, I'm available to consult project managers and design managers in early project start up phases, as well as consult on resolving collaboration issues on current projects.

Further, I'm available to assist management in departments, sections, divisions and organization with the implementation of Integrated Design-Build Management across projects. Specific examples include, participating in early conversations with potential project owners, politicians, consultants and suppliers, facilitating the development of process logics for design processes, facilitating collaboration workshops and collaboration evaluations during planning and design phases. Finally, I'm able to assist pre-qualification teams, tender and bidding teams, the tender and contract board, by analyzing risk and opportunities for collaboration and potential conflicts of interests and cultural understandings in projects.

If you want to know more

The following literature is recommended if you'd like to know more about integrated project management, management of cultural understandings and integrated projects:

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This publication summarized a three-year long research project carried out by Lea Urup in collaboration with MT Højgaard and Chalmers Technical University from June 2013 to June 2016. The research project builds on a qualitative study of six design-build projects in MT Højgaard and sheds light on how coordination is enabled (and constrained) in projects. The research project interprets coordination as a matter of creating shared cultural understandings, norms, processes and rules for predominantly project initiation and planning, design, and construction, but also occupation and facility management. Furthermore, the research project sheds light on the relationship between coordination of cultural understandings during design and construction phases and the projects' final performance. Last, but not least, the publication presents the research project's recommendations as to how organizations in the field can change existing and create new cultural understandings and norms aimed at increasing project coordination and performance.

