

HOW TO ADOPT COLLABORATIVE PROJECT DELIVERY MODELS IN A MATURE INDUSTRY

– THE CASE OF CRUISE SHIP BUILDING

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May 17, 2023

1. INTRODUCTION

Early involvement of key partners in project delivery is an important part of collaborative project delivery (e.g. Lahdenperä, 2012). The acquisition of the best knowledge by engaging key partners in the planning and design phases of projects, is a key ingredient in several papers on collaborative project delivery models (Nwajei, Bølviken & Hellström, 2022). Using the best possible expertise in all the specific areas of the projects in early phases of projects is likely to increase innovativeness of the projects, which, in turn, results in cost savings during the later phases of the projects and increases the value of the end results. This is especially important in the cruise ship industry, where every ship generation strives to offer the travelers a new and unique experience to attract both old and new customers to the cruises. At the same time, there is a constant challenge to keep the costs of these mega projects under control as "timing giant projects" is known to be difficult (Grün, 2004).

There are five main parties involved in the procurement of a cruise ship; the architects, the cruise line (owner), the shipyard, the suppliers to the shipyard, and the classification societies. While they are all experts in their respective fields and surely share the end goal of building the best possible cruise ship for the passengers, their insight in how to achieve this goal may differ. Architects may want to design extravagant cruise ships which impress both the passengers and the owners. The owners ask for novelty at a reasonable price. The shipyard asks for less complexity and iterations. The suppliers need enough time for their deliveries. Due to time, price and other pressures arising between these groups, it easily dents collaborative innovation leading to less than optimal solutions in the end.

A characteristic of the industry is that the cruise ship operators purchasing the ships, tend to have clearly better profitability compared to the shipyards being responsible for building the ships. With pre-Covid operating profit margins usually in the low single digits, the world's most prominent cruise ship shipyards (Fincantieri, Meyer and Chantiers de l'Atlantique) have a clearly lower profitability compared to the close to 20% profit margins reported by the big cruise ship operators (Royal Caribbean Cruise Lines, Norwegian Cruise Lines and Carnival Cruise Lines). It also seems that the cruise liners' profitability has been slightly rising in the last decades until Covid-19 hit, possibly due to economies of scale as the size of the cruise ships have grown (Syriopoulos et al., 2022). The shipbuilders, on the other hand, seem not to show

increasing profitability but appear destined to low profit levels and in some years even losses. On the other hand, with the increasing size and complexity of the ships, one could argue that the risks of the ship builders have increased in recent times, leading for example to the bankruptcy of the German cruise ship builder MW Werften in early 2022. Yet, cruise ship building remains a complex endeavor requiring highly skilled workforce with limited repeatability between the projects in the series of ships in one generation.

1.1 Research motivation and aim

Finding ways to incorporate collaborative project delivery models and through them to enable early involvement in old and mature industries, like shipbuilding, will improve the knowledge on collaborative project delivery. More importantly, it will potentially increase the efficiency and sustainability of industries still operating in conventional ways. Generally speaking, the ship building industry is a regulated and thereby also conservative industry that has been operating in the same way for decades, if not for centuries.

In this paper, we investigate the challenges to use collaborative project delivery models in the cruise ship industry, and more specifically, in the contracting and design phases of a new cruise ship. Designing a cruise ship is a very complicated process involving a large network of partners (Keiramo, 2021). Due to its long history, the way of working in the shipbuilding industry has become institutionalized. This has undoubtedly contributed to an efficient production process of unique products. However, when exploring ways to increase performance in the shipbuilding process, the same institutions constitute lock-ins forming barriers for further improvements (Eriksson et al., 2019). Therefore, our aim is to identify the major lock-ins preventing collaborative procurement methods to gain wider use in cruise ship building and to propose paths to overcome these obstacles.

2. COLLABORATIVE DELIVERY AND CRUISE SHIP PROCUREMENT

In construction, there has already long been a call for more collaborative approaches, especially in more complex projects, in order to increase productivity in the industry. Collaborative approaches mean moving away from conventional arm's length relationships between the buyers and the sellers towards relational ones building on trust and common goals (Nwajei, 2020). To this end, the use of alliance or integrated project delivery (IPD) contracts have gained lots of interest over the past two decades in construction (Lahdenperä, 2012; Walker & Lloyd-Walker, 2015). Essentially these build on goal alignment and risk and gain sharing. A number of functions and methods, typically originating from the lean production philosophy, have been introduced as part of such contracts, among them early supplier/contractor involvement (Nwajei et al., 2022).

Early supplier involvement is a well-known approach in high-volume (mass) industries. In project business it is more difficult to handle due to the one-off contractual approach, although the benefits of better use of the contractors' and the supplier's expertise in the early stages of a project are acknowledged. In short, the dilemma is that the buyer does not

want to commit to a single supplier too early while the supplier does not want to give away its expertise for free.

Hellström et al. (2021) define a new type of delivery model with early engagement and a systemic view of the expected benefit from the delivery. The systemic view means that the delivery model also considers the life-cycle expectations and benefits at the design stage. Hellström et al. also call for a broader view than the traditional dyadic relationship between owner and contractor involving also other relevant actors in the design process. This type of delivery model with a systemic view takes a larger responsibility of innovation and management of uncertainty emphasizing opportunities and being more flexible in the approach. The management approach leans more towards program management (and partnering) than traditional one-off project management (at arm's length).

Cruise ships typically develop in generations, each generation being built in a series of (sister) vessels, which however are contracted on a one-by-one basis (sometimes as options to extend the contract to one or a few sister ships that are, however, negotiated and priced individually). The first ship in a series typically has a higher degree of innovation). It is also noteworthy that a cruise ship consists of an extensive amount of various physical areas and systems. The degree of novelty and need for innovation differs largely among these areas and systems. Some areas are based on previous reference ships and thereby the degree of uncertainty and need for innovation is low. Other areas and systems are the opposite with a large portion of uncertainty and need for innovation. This most probably impacts on the collaboration need at various phases of design. Various schemes of collaboration and contractual setups for various areas and systems are already now common for the procurement processes and could be further developed.

There has been increased empirical analysis and concept development of new types of procurement structures such as alliances (Walker and Lloyd-Walker, 2015), early contractor involvement (ECI) (Wondiumu et al., 2020) and various types of multi-party agreements, especially in public projects. Benefits may be design innovations, novel or cost-efficient material selection, and improved buildability and lowered construction risk. A contribution to the design process is likely to create a more trustful collaboration in the teams. Contractors may also have valuable input to the cost plan and time-schedule, hence, increasing their validity.

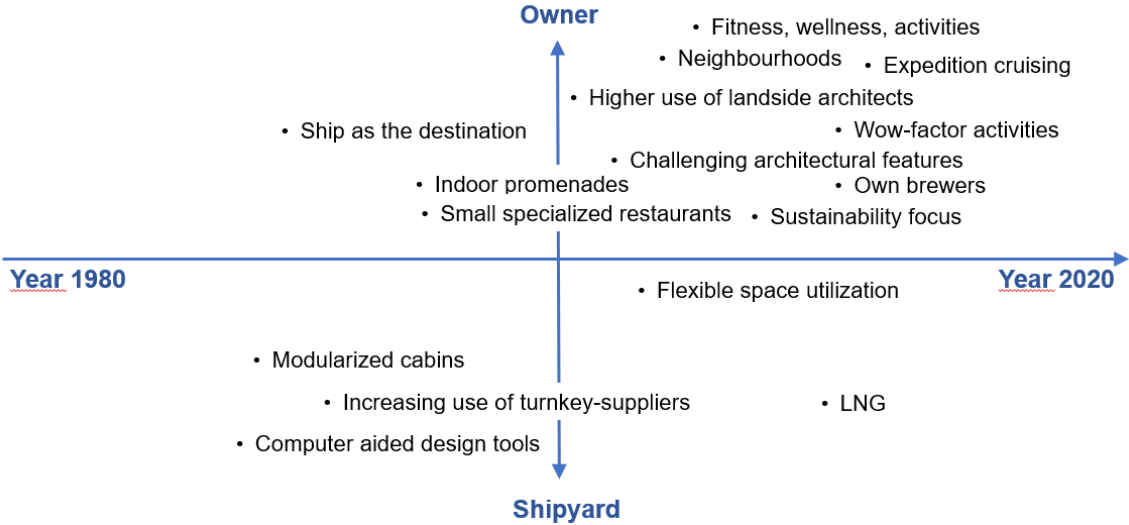
For the shipyards, there are surely benefits to be gained using collaborative project delivery methods. These methods can lead to more balanced risk sharing, smarter solutions and less iterations during the planning and building phases of the ship. The future cruise ships continuously need higher levels of expertise and innovativeness to attract demanding customers. To satisfy and overcome these customers' expectations, it is also in the cruise liners' interest to ensure that the ship building ecosystem remains intact, motivated and focused on bringing the best possible cruise ships to the market. The current rigid and transaction-focused ways of operating make it inefficient and many of the risks in the procurement of a new ship are not optimally distributed among the partners. Forgoing incremental innovation, this setting results in various moral hazard and adverse selection

problems and makes it difficult for the industry to adjust to the increasing sustainability requirements and to deliver the system-level innovations needed for that.

Structured and early engagement of people with various know-how is important in the early phases of ship design and is likely to lead to outcomes including the latest innovations and technologies. While suppliers’ involvement in the ship generally starts with the technical design phase, the goal would be to get involved already in the concept design phase (Keiramo et al., 2018; Keiramo, 2021; Hellström et al., 2021.). The problem is how to achieve this without some partners giving away their knowledge for free and/or others being able to use their position in the early phase to increase their income from the projects.

Over the last decades the cruise ship owner's role has increased in shaping the new ships as figure 1 shows. A trigger for this development has been the shift in the business model of the ship owners to focus more on making the ship itself the destination instead of the places the ship visits during the cruise. The importance of providing customers with more value for their money through various activities and experiences has grown in importance.

Figure 1. The owner’s changing role in the concept design of cruise ships



3. METHODS AND DATA

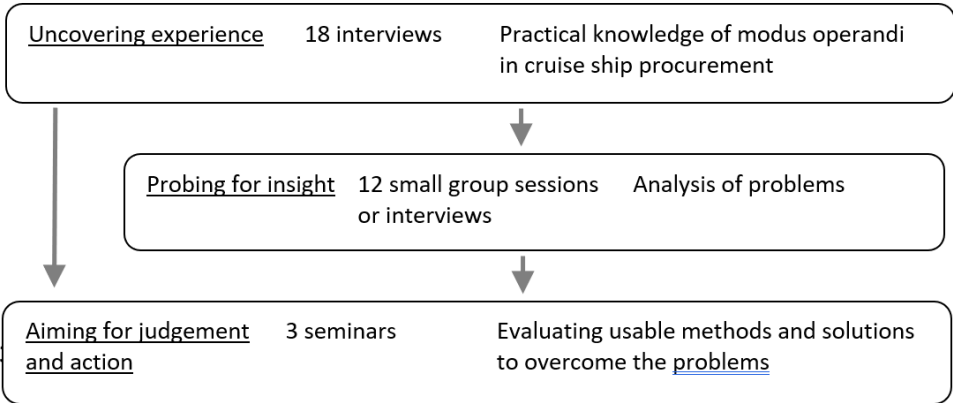
Our research method is clinical. Clinical/inquiry research (CIR) focuses on solving problems that are relevant for practitioners (Coghlan, 2009). In CIR the researchers focus on helping the parties which are affected by a problem to find solutions for the problem. In this process, the researchers aim together with the parties to explore, diagnose and act on the new information when they emerge (Coghlan, 2009). Much of the data generated is “real time”: It is created in the process and not only made up for the research project. The CIR method has been successfully applied to unstructured problems with wide and vague boundaries including

many stakeholders (e.g. Eriksson et al., 2019). The study has been conducted as part of a joint R&D project, in which the researchers together with a shipyard and three key collaborators with different shipyards (i.e. first tier suppliers and service providers) have joined forces to tackle the challenges with collaborative delivery

In this study, we are concentrating foremost on the design and procurement of selected areas of the ship; galleys, restaurants and elevators. Especially galleys and elevators are complex constructs requiring expert knowledge which usually only the solution suppliers have and master. At the same time, these areas are vital and must work properly to ensure that the passengers are happy with their cruise experience. Examining different areas and actor types (architect, ship owner, shipyard, suppliers) also enable us to develop contextualized models that are contingent upon the requirements and properties of the different areas of the ship.

We divided our research according to the three stages of the collaborative process of clinical research laid out in Coghlan (2009): uncovering experience, probing for insight, and aiming for judgement as well as action (see Figure 2). We tackled the first stage of identifying the problems by our material of one-on-one semi-structured interviews with ship building specialists. This was done by using the transcripts of 18 open-ended semi-structured interviews conducted by one of the co-authors for her Ph.D thesis (Keiramo, 2020). The interviews focused on the concept design phase of cruise ship procurement. The interviewed persons held or had held key positions in the field of product design and development, naval architecture, architectural design, and engineering of cruise ships at various companies. The interviews were conducted in 2018 and 2019 and their combined length is 18 hours and 41 minutes leading to 281 pages of transcripts.

Figure 2. Three steps in the research process



Based in the interviews, we identified ways of operating which were not in line with collaborative project delivery methods. In the next phase, probing for insight, we arranged 12 small group sessions or interviews (specified in table 1) with the shipyard, an architect bureau, two big suppliers as well as one major cruise line. The participants in these meetings varied,

sometimes they were only participants from one company whereas other sessions included several of the parties involved. The participants were architects, technical designers, product developers, project managers and one contract specialist (lawyer) all being directly involved in the procurement of cruise ships.

In the six workshops involving more than one company and three to six participants, the problems were discussed between the partners and solutions sought in the group. In the six open-ended semi-structured interviews only representatives from one company were present. The objective of the interviews was to gather more in-depth and often sensitive information of the problem from the perspective of the companies involved. This company specific background information made it easier for us researchers to plan and direct the sessions when we had a better picture of possible tensions between the participants.

Table 1. Small group sessions and interviews

No.	Date	Field of expertise	Company types
1	16 Sept 2022	Technical design	Supplier
2	23 Sept 2022	Architecture, technical design, prod. development	Architect, shipyard, supplier
3	23 Nov 2022	Architecture, technical design, prod. development	Architect, shipyard, supplier
4	12 Jan 2023	Architecture, technical design, prod. development	Architect, shipyard, supplier
5	7 Feb 2023	Technical design, prod. development	Shipyard
6	3 Mar 2023	Technical assurance and design	Cruise line
7	11 Mar 2023	Architecture, technical design, prod. development	Architect, shipyard, supplier
8	21 Mar 2023	Contract law	Shipyard
9	27 Mar 2023	Architecture ³	Architect
10	20 Apr 2023	Product management	Shipyard
11	26 Apr 2023	Technical assurance and design, prod. development	Cruise line, shipyard
12	4 May 2023	System sales, technical design, prod. development	Shipyard, supplier

Before the last step, aiming for judgement and action, we used all the insights gathered from the industry parties involved to come up with possible solutions to the chosen problems identified. These solutions and ways of action were then proposed to all parties involved in this research to validate them by the industry experts.

The seminars included partly the same participants who participated in the workshops and interviews as well as more senior personnel from the companies involved. The participants in the seminars ranged from six to nine. These seminars act part as steering group for the workshop and part as the body approving and discussing the viability of the solutions and change of work practices which were identified in the probing for insight phase. In all we have had three seminars (on 26 Aug 2022, 4 Nov 2022 and 19 Jan 2023).

4. ANALYSIS

4.1. Uncovering experience

Based on the interviews in the uncovering experience phase several same problems were mentioned by the experienced professionals in the cruise ship industry. The interviewees often also proposed various solutions to mitigate the problems and expressed opinions on what the potential results could be. The most often mentioned problems and their possible solutions and results are in table 2.

Examining the problems, we see that the majority of them are quite specific, usually concerning a narrow work task or phase in the early phases of cruise ship procurement. We get a picture that the problems are often related to the procurement process. Based on the interview transcripts, it is evident that the ways of operating in the ship building industry have long traditions.

Table 2. Problems identified in the interviews

	Problem	Possible solution	Potential result
1	Designers and planners do not have access to the same ship model real-time	Knowledge sharing database	Higher efficiency and better end-result
2	Suppliers are not allowed to design/build the best solution	Get clients to approve suppliers' better solutions by communicating benefits	Cost savings and better usability
3	Suppliers may have very short visibility of when deliveries are expected	Improved visibility to suppliers	Less delays in deliveries
4	Inability to freeze the essential measures of the ship in an early stage	Improved concept design quality	Higher efficiency and better end-result
5	The architect sets impossible requirements creating inertia at the shipyard	Better attitudes and collaboration between architects and shipyard	Better balance between design and cost
6	The person with the best knowledge is seldom the one making decisions	Clear division of responsibilities/mandates	Better solutions at lower cost

4.2. Probing for insight of how to mitigate change

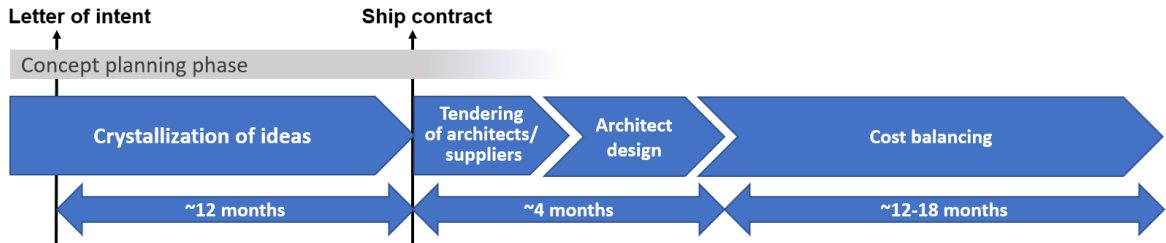
The insights which were revealed to us in the interview transcripts, were mostly familiar to the participants in the second and third phases of our study. We realized that, even if the problems identified in table 2 above, were actual and real problems they were also symptoms of broader overhanging problems in the cruise ship procurement. Based on the discussions in the second and third phase of our study, it appeared that there was a lack of trust between several of the most important partners in the procurement process and failure to prioritize the project outcome. Some partners, and not necessarily any of the ones participating in this study, are allegedly much more interested in maximizing their short-term profits on the

expense of the project outcome (i.e. the best possible cruise ship at a given cost). Much of these two unfavorable problems seemed to be grounded in the early phases of the cruise ship procurement.

Cruise ship procurement is a long process, based on the discussions with the industry veterans spanning across a range of companies, a general and simplified version of it is described in the following. Cruise ship procurement usually starts with a letter of intent between the cruise lines and the shipyards through which a slot for building the ship is scheduled. This letter of intent or preliminary agreement is the starting shot for the ship building contract and it is signed several years before the actual building of the ship starts. After the preliminary agreement, the shipyard and the cruise line negotiate the ship building contract which can be signed about a year after the preliminary agreement. In the ship building contract, the price and specifications for the ship are set. The price and design are based on an earlier built ship which is called the “reference ship” of the contract.

After the letter of intent is signed, the concept planning of the ship kicks off. When the ship building contract is signed the crystallization of ideas should have led to a general arrangement (GA) plan in which the main outlines of the ships are specified. The GA shows the shape of the hull, the floor layout on each deck but not any specific construction details. With the GA and ship building contract in hand, shipyards tenders suppliers and the cruise lines tenders and hires an architect to make basic and detailed architectural designs of the ship. At the end of this phase the detailed specifications for the ship to be built are ready. The detailed specifications for the ship are used for the cost balancing phase which can last 1 to 1.5 years. During this phase the shipyards, the cruise lines and to some part also certain key suppliers match the detailed specifications received from the architect to the original ship building agreement. This cost balancing involves a lot of negotiating, calculating and comparing and is often a costly and cumbersome process.

Figure 2. The time-line for cruise ship contracting



The contracting period showed in figure 2, is equipped with challenges. In our group sessions and interviews, we identified that the involvement of suppliers in the early phases of the concept planning is challenging. The importance of communicating and incentivizing suppliers in ship building projects to enhance project value has been pointed out previously (Ahola et al., 2008). This problem still exists and easily leads to mistrust and loss of value if not handled correctly in the very early phases of the project. The other source which based on the group

sessions and interviews turned out to be problematic and a source of much annoyance between the partners is the cost balancing phase. During this phase the owner, shipyard and suppliers match the designs and costs from the ship contract to the outcomes after the architectural design phase.

All in all, we identified that incentivization of suppliers early on and improving the cost balancing process, both materially affect the trust and work outcomes of the partners. Positive contributions to these two issues could bring several upsides and not only helping to solve the specific problems listed in table 2. Increased trust and more value-add from suppliers in the early phases would probably lead to lower costs, better risk management and in the end, better cruise ships delivered on time.

4.3. Aiming for judgement and action

In our empirical work, two major areas of improvement stand out: shifting from a reference ship- to reference level-based design and early involvement of suppliers.

4.3.1 From reference ship contracting to level benchmarking

The cost balancing problem is linked to the custom ways of contracting the construction of a cruise ship based on the reference ship method. In this method, which is typically used for the first ship (of a new ship series or generation), the price of the new ship is based on a previously built ship, i.e. the reference ship. When the architect design drawings are ready, they are matched to the reference ship designs. Differences in design are noted for each of the defined spaces and then a price difference for the new designs and the reference ship design is calculated per measure of the space (often square meter).

The used materials and of constructions are main sources of the price differences between the reference ship and the new ship. For the spaces where the new ship has more complicated designs or costlier materials compared to the reference ship there will be an add to cost which is netted against the cheaper designs made in the new ship. The cost balancing is a tedious task involving a large number of calculations and negotiations affecting also suppliers. The task may require the involvement of many employees and it may go on for a long time. This all comes as an additional transaction type of cost for both the ship owner and the ship builders. However, the biggest cost may not even be the direct personnel expenses but the loss in trust between the ship owner, the shipyard and the sub-contractors. In the process, the companies may abandon to think what is best for the project and instead start thinking how to maximize their own short-term profits. In one of the group session meetings one participant described the cost balancing as a mission in which the parties involved together “agree to fail”.

The reference ship based contracting also has other downsides. Some of the technical solutions made in the reference are difficult to replicate due to the fact that some components or materials used are not available anymore. There may also be more developed and even

cheaper solutions now available, but the construction price is based on an older and more expensive solution. As the designers have to start the modernization from a solution which tends to be several years old, the leap to design something which is modern when the ship is finally built is big. The workload and time constraints in the concept planning and cost balancing phases may lead to less-than-optimal solutions. In one of the seminars, a supplier pointed out that the reference ship method also has certain advantages and indeed is a convenient method that sets off the design process. During the interviews and group sessions several designers and product developers expressed their concern over the high number of iterations during the planning of the new ship. These rounds of iterations may partly be due to the big leap which is made from the reference ship increasing uncertainty into the designs.

In this study, representatives both from the ship owner and shipyard expressed willingness to try alternatives to the reference ship model. One development is to use reference levels instead of a reference ship. Reference levels are standardized quality levels of various spaces of the ship and are used in the construction industry. The price and designs in the ship could be benchmarked against, for example, three different quality levels; budget, main and premium. As the names indicate they would go from a cost effective option to an option offering high quality in both materials, accessories and design choices. The various levels could be demonstrated through computer visualizations and specifications.

This could bring several advantages compared to the reference ship model. First, the levels could be developed continuously together with the main partners (ship owner, shipyard and suppliers). Continuous updating would mitigate the time pressure to make the bigger leap from the reference ship solutions to the state of the art of the day the ship is being built. New dimensions could be advanced in the planning besides the typical focus on cost, functionality and quality, such as, for example, sustainability considerations regarding material usage. Secondly, the quality levels and their visualizations would not be as one-off designs as the designs are today. The quality levels could lead to a higher degree of standardization of spaces in ships. Our interview and group sessions as well as previous research (e.g. Brett et al., 2018) indicate that the standardization of cruise ship design will increase and this is likely to decrease procurement costs in the future.

4.3.2. Collaborative engagement in the concept design phase

In the early phases of cruise ship procurement, the partners with best knowledge should be utilized to contribute to the project. How to create the best environment so that the partners share and work towards achieving the same goal. This is a question of incentivization and risk sharing. Based on our discussions during the probing for insights and aiming for judgement and action, we have identified the communication between the owner, shipyard and suppliers to have asymmetries. In the contracting phase the suppliers do not entirely know what they are expected to deliver in the end. This is probably due to the complexity of the project and the usually tight time schedules (figure 2).

All participants see it as a good thing that the suppliers are involved in an earlier stage in the process, but how to accomplish this so that it is mutually fruitful can be a problem. The owner

and shipyard may not want to be locked-in with one supplier without tendering and the supplier tries to avoid giving away ideas and work input for free (without a guarantee for being rewarded with a contract). Both of the two suppliers in this study pointed out that they have been involved in the planning phase of projects abroad where their work has been given to somebody else who got the contract.

As mentioned, a ship consists of a large number of areas and systems. As the level of complexity, risk and need for innovation differs a multifaceted approach is already in use today in the procurement process. Traditional transactional procurement is used and works well for large parts of the ship. The areas and systems with high need for innovation including risk need to be further developed as outlined in this paper.

A related problem is the incentivization to put in effort for the best of the project. There should be an appropriate risk/reward system in place between the owner, shipyard and supplier. A supplier putting in work to save substantial amounts of costs or increase the value of the project, may not be rewarded whereas it increases the supplier's risk. This can be illustrated by quote from a designer who took part in this study:

“Even if I have a hunch that I can find a material which looks the same and has the same specifications [compared to the one the main architect has chosen] but costs clearly less, why would I do it? To bill two more hours when somebody else reaps the cost savings which could easily be in the five figures? In the end, the switch also comes with some risks for me [if there is something wrong with my choice whereas the architect bears the risk for the default material].”

- 11 March 2023, group session

At this stage of the study, we have investigated alliance model –type open book profit sharing models to mitigate the incentivization problem. In the aiming for judgement and action phase of our study, the senior participants are not convinced that open-book methods would work. The participants did not think that the companies involved would want to make their cost structures visible to each other. The shipbuilding industry also have traits which previous research have stated to be problems in open-book contracting, such as large differences in the firm sizes forming the alliance and having constraints on their economic performance (Kajüter & Kulmala, 2005).

Another idea would be modular contracting by separating those areas of a new ship where more radical innovation is either desired or where one knows that things will change from the reference ship. In those areas more intensive collaboration could be pursued in the early phases.

5. CONCLUSION

In this paper we investigated the challenges to use collaborative project delivery models in the cruise ship industry, and more specifically, in the contracting and design phases of a new cruise ship. Our aim was to identify the major lock-ins preventing collaborative procurement methods to gain wider use in cruise ship building and find paths to overcome these obstacles. The research was based on 23 interviews, 6 group sessions and 3 seminars with senior personnel from a cruise line, shipyard, architect bureau and two suppliers.

Ship building is characterized by long traditions which is evident in our results. The cruise industry is currently affected by large changes concerning passenger demand and sustainability issues. The need for new innovations increases friction of the traditional ways to procure cruise ships. We identify specific problems in cruise ship procurement and see them as symptoms of a bigger overhanging problem; lack of trust between the partners. We have identified two harmful work phases in cruise ship procurement which especially wear on trust and escalate conflict and are able to propose a change for one of these.

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