Adaptive Subcontractor Management

A process design for main contractors to shape their subcontractor management approach

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Abstract

Many large engineering projects continue to face late completion dates, budget overruns and technical difficulties. This problem is becoming increasingly relevant as the boundaries of organisation are shifting through companies’ increasing usage of outsourcing. Although offering many advantages, this working model of outsourcing also poses new challenges for main contractors responsible for the realization of large engineering projects. This paper presents the results of a master thesis research conducted at luxury yacht builder Oceanco. The process design developed during this research enables main contractors to make an informed decision on their subcontractor management approach. The process design proves to challenge current practises at Oceanco. Project management professionals from several other industries also value the comprehensiveness of the process design. The presented subcontractor management canvas was received well by the organisation of Oceanco, but could not be validated for other main contractors. The potential of this canvas justifies further research in this direction with a variety of case studies of main contractors operating in other markets.

Keywords: subcontractor management, procurement, main contractor/subcontractor relationship, contracting, large engineering projects

1. Introduction

Many large engineering projects are faced with late completion dates, budget overruns and technical difficulties (Koppenjan et al., 2011). Reasons given for such project failures include, but are not limited to, increasing complexity of projects and the underestimation of this project complexity (Chang & Ive, 2007; Williams, 2005). Projects have become increasingly complex due to their increasing size and use of state-of-the-art technologies (Koppenjan, Veeneman, van der Voort, ten Heuvelhof, & Leijten, 2011). Additionally, many companies have returned to their core competences in order to stay competitive (Andersen, 1999; Aritua, Smith, & Brower, 2009). Main contractors in large engineering projects increasingly resort to decentralisation and are decomposing their work by co-operating with an increasing amount of subcontractors. Although offering many advantages, this working model also poses new challenges for main contractors in managing their projects successfully (Williams, 2005). Arguably the most important of these challenges has become the main contractor’s dependency upon their subcontractors (Williams, 2005).

Oceanco, a shipyard of the upper segment luxury yachts, is an example of a main contractor managing large engineering projects that returned to its core competences in 2005. The strategic decision to outsource all production work needed for the construction of a yacht implies that Oceanco works with many subcontractors and is dependent on their performance for the success of their projects (Oceanco, 2013).

The working relationship between the main contractor and the subcontractor has traditionally been mainly hierarchical and transactional in nature, with both parties seeking to secure added value at minimum cost (Miller, Packham, & Brychan, 2002). Procurement in this traditional working relationship is done purely based on price, which entices tenderers to lower their bids to win a contract and rely on subsequent claims to recover their costs (O’Conner, 2009). The room for a subcontractor to excel in such an adversarial collaboration is limited, as the contract is the strict guider of the subcontractor’s performance and interactions between the main contractor and the subcontractor are few (Larson, 1995). Disputes are resolved by formal interpretation of the contractual obligations. Moreover, contracting parties may interpret contract clauses differently (Rahman & Kumaraswamy, 2004; Hartman, Snelgrove, & Ashrafi, 1997) and for their own benefit (Clegg, 1992). Contracting parties often work through the motivation created by divergent objectives and hidden agendas, showing strategic behaviour (De Bruin & ten Heuvelhof, 2008; Rahman & Kumaraswamy, 2004).

To reduce the gap between expected and actual performance of the subcontractor, and to create long-term collaborations that are characterized by mutual benefits, other selection criteria and management approaches are needed (Mills & Skitmore, 1999; Bygballe, Jahre, & Sward, 2010). An example of a management approach that uses different selections criteria to reduce the gap between expected and actual performance of the subcontractor is known as partnering.
(Walker, Hampson, & Peters, 2000). This approach is mainly founded on an element of mutual cooperation and allows main contractors to specialize in core activities and rely on external partners for additional technological input (Wood & Ellis, 2005). The interdependencies between the main contractor and subcontractor that are created by this reliance lead the way to cooperation, as parties are becoming aware of this mutual dependency (Anvuur & Kumaraswamy, 2007; White & Marasani, 2014). However, partnering also conserves certain drawbacks, as its informality may lead to unprofessional behaviour, condoning mistakes and result in underperformance (Alderman & Ivory, 2007).

The contrast present between the two approaches mentioned in this introduction illustrates the unlikelihood of the presence of a ‘plug and play solution’ to subcontractor management. It is unclear in what situation which management approach to subcontractors would fit best. This paper presents the results of the effort of Brockhus (2015) to provide guidance for main contractors in shaping their management approach to subcontractors upon the subproject’s context. The general goal is to provide main contractors with a framework that allows them to make an informed decision on their subcontractor management approach.

2. Research method
The process of problem solving is adapted from Mitroff et al. (1974). This process starts with an identification of the perceived problem (to be found in the introduction), followed by the construction of a conceptual model – a model on subcontractor management – and an empirical model: the process design. As the study considers a contemporary real-life situation on which the researcher does not have a strong influence, a case study approach is followed (Yin, 2003; Bosch-Rekveld, 2011). For the case study an in-depth research is performed at a main contractor that manages large engineering projects: Oceanco.

Specifically, we are interested in how the characteristics of its projects influence the way they manage their subcontractors. This information is gathered using available yearly reports, publications, and interviews with employees. Analysing the current approach to subcontractor management attention is paid to the barriers and challenges the main contractor faces. Projects of interest are defined as having:
- A budget between 100 and 250 million euro
- Commonly practises change orders
- Use of state-of-the-art technologies
- Majority of the work outsourced

The information obtained from the case study is used to construct a conceptual model on subcontractor management, which steers the literature research that is forming the knowledge base. Parallel to the gathering of information from the case study a desk research on subcontractor management is conducted. First, theories on projects and their management are gathered to obtain knowledge on how subcontractor management is embedded within project management. Second, theories on the management of subcontractors are explored. Third and final, the influence of the contract, risk and change orders is researched. For the literature study articles as well as websites and other available written materials are analysed. Scientific articles are obtained from Scopus, ScienceDirect, Google Scholar and Web of Science.

The empirical model is based upon the results from the case study and the literature study. By application of the design at Oceanco and by consulting different experts from the market (project managers managing large engineering projects) the (scientific) value of the process design is analysed. The latter shows the applicability of the process design for other main contractors facing similar challenges. The process design is also contrasted with the main bodies in literature. Together this forms the discussion part of this paper.

3. Case study
The luxury yacht builder Oceanco is the subject of the case study in this research. Oceanco has a relatively unique business model in comparison to other builders in the luxury yacht industry, as it outsources 90 to 95% of its added value to subcontractors, where competitors perform most of the work in-house (Oceanco, 2013; RVL Holding, 2011).

In general Oceanco’s management approach towards its subcontractors can be considered as quite traditional (Brockhus, 2015). Although they make a distinction between non-critical suppliers, preferred suppliers and co-makers, they reward the types of subcontractors similarly: via a fixed price agreement. This entices all scope changes to be formally recognized by means of a change order and handled according to a standard procedure. The written procedures generally do not account for the relationship with the subcontractor and therefore the management is to a large extent based on the gut feeling & tacit knowledge of the purchase manager and the project manager.

The case study of Oceanco has brought forward a number of challenges in the management of their subcontractors (Brockhus, 2015). Firstly, the increasing dependence on the expertise of the subcontractors, as their projects are becoming larger and more complex. Secondly, the limited availability of subcontractors that can deliver the level of performance needed for the desired quality gives these subcontractors a certain bargaining position. Thirdly, the number of change orders that are inextricably bound to the construction of large projects directly for the client requires flexibility from both Oceanco as well as their subcontractors.
The case study at Oceanco has given insight in how subcontractor management is performed within the organisation. Subcontractor management seems to be not bound by project boundaries and embedded in multiple levels of the organisation. Oceanco often works with subcontractors on multiple projects and builds long-term relationships with these subcontractors. This relation or history with the subcontractor is likely to influence the choices made by the purchasing department and the project manager with regards to the subcontractor management approach. Besides, the relationship with a subcontractor is also likely to influence the negotiations between the main contractor and the subcontractor. The outcome of the negotiations is the set of agreements that will determine how the subcontractor is evaluated and rewarded, and how the risks and changes of scope are managed within the project. The outcome of the negotiation shall therefore influence the performance in the project.

It is therefore assumed that the process of subcontractor management is shaped by the interactions between relation, negotiation and project (performance). The relation influences the negotiation, which will influence the project and its performance. The project performance will eventually influence the relationship by means of a feedback loop, as experiences and interactions shape the relationship between the main contractor and subcontractor. The development in the relationship will subsequently influence the negotiation and performance of the next project (see figure 1).

Knowledge base
The knowledge base is divided in two parts, following from the model of subcontractor management: the first part is about project (performance), the second about negotiation & relation.

Project (performance)
The research on the level of project (performance) has led to some important insights with regards to subcontractor management. The concept of a project is being described by literature as a temporary effort undertaken to create a product, service or result (Project Management Institute, 2008). This definition entices that there are common phases in each project, which makes comparison possible (Turner & Cochrane, 1993). Furthermore, the schools of thought on project management show pluralism in project management research (Söderlund, 2011) and steer the efforts of creating the process design into a model that embraces this pluralism.

There is no 'plug and play' approach for project and subcontractor management; the management approach should be made contingent on its context (Bosch-Rekveldt, 2011). Literature reveals that the management approach in a project largely determines the degree of freedom the subcontractor is given. The performance indicators of cost, quality and time, better known as the Iron Triangle, mainly drive the choice for the management approach (Atkinson, 1999). The relation is often neglected in this choice.

The literature on the concept of project success re-emphasizes the importance of time and scope; whether a project is successful depends on the (time) perspective one takes (Shenhar, Dvir, Levy, & Malz, 2001). This can also be observed in the subcontractor management model (figure 1), which considers subcontractor management at both project and portfolio level, as the relationship between a main contractor and subcontractor exceeds project boundaries and influences subsequent projects.

Risk was found to be central to complex projects as one of the main, if not the main, driver in project management (Kerzner, 2013). Not the identification of risks, but the mitigation strategy one chooses is argued to be difficult (Raz & Michael, 2001). The construction industry is mainly risk-averse and tries to transfer the risks towards their subcontractors, so the mitigation strategy becomes the responsibility of the subcontractor (Akintoye & MacLeod, 1997).

Negotiation & Relation
Although every project and subcontractor is unique, a certain degree of segmentation is useful and necessary in order to give insight in how the effectiveness of a subcontractor approach can depend on subproject and subcontractor characteristics (Camuffo, 2007). Using Turner & Cochrane (1993)’s segmentation model of projects four types of subprojects are identified: catalogue, performance-based, exploration-driven and
blue-sky subprojects (see figure 2). Additionally, four types of subcontractors are identified based on Kraljic’s segmentation matrix (1983): non-critical, leverage, bottleneck & strategic subcontractors (see figure 3). The type of subproject and subcontractor are used as input for the process design on subcontractor management.

![Figure 2 Segmentation of subproject (adapted from Turner & Cochrane 1993)](image)

The main trends in subcontractor management have been researched in more detail. In literature a shift can be observed that is moving away from the traditional adversarial approach towards approaches like partnering, alliancing and integrated project delivery (Miller, Packham, & Brychan, 2002; Gadde & Dubois, 2010). These approaches put more emphasis on the importance of a good relation between the main contractor and the subcontractor and are founded on features like early involvement of key parties, transparent financials, shared risk and rewarding, joint decision-making, and a collaborative multi-party agreement (Lahdenpera, 2012).

The concept of relation is analysed by key relationship indicators (Meng, 2012). The study uses ten indicators that describe the supply chain relationship, based on common factors in the studies of Chan et al. (2004), Hellard (1995), Black et al. (2000) and Crane et al. (1999): mutual objectives, gain and pain sharing, trust, no-blame culture, joint working, communication, problem solving, risk allocation, performance measurement, continuous improvement.

![Figure 3 Segmentation of subcontractors (adapted from Kraljic 1983)](image)

The contract plays an important role in the collaboration between main contractor and subcontractor. Naturally there is no single form of contract agreement that will fit every situation or project (Kerzner, 2013). However, following the guiding principles of Relational Contract Theory arguably ensures that the relation is taken into account in the negotiation (Veen & Korthals Altes, 2011). In general, companies make use of one of the following contract forms: fixed-price or lump sum, cost plus fixed fee, cost plus percentage fee, guaranteed maximum and shared savings, fixed-price plus incentive fee or cost-plus incentive fee (Kerzner, 2013).

4. The process design

The subcontractor management approach should arguably be determined by the context of the subproject and subcontractor. The developed process design therefore does not prescribe a single subcontractor management approach that will work in each situation, but enables the main contractor to make an informed decision on the management approach to follow.

As projects are seen as a planned set of interrelated tasks to be executed over a certain period of time, certain decision moments considering the subcontractor management approach can be identified. Using Eriksson & Westerberg (2011)’s framework on cooperative procurement procedures, seven decision moments in the process of subcontractor management have been defined. Three organisational levels (strategic & relational, project & negotiation and operational) are used to structure these decision moments in the process. Furthermore, the type of subproject, type of subcontractor and the influence of relation are used as input for the process design. Elucidation of the process design is given below. The process design is presented in figure 4.

Strategic & Relational Level

Subcontractor management is a continuous effort for the main contractor, often characterized by repetition of collaborations with certain subcontractors. On the strategic and relational level of subcontractor management the management of the companies’ portfolio takes place. Portfolio management entails the selection of projects and the general planning for all projects, based on the available resources within the firm. On this subcontractor management level the decision can be made to engage in a long-term agreement with a subcontractor by means of a framework agreement. Such a framework agreement holds for a term transcending the project lifecycle. This decision is assumed to be mainly influenced by the relationship between the main contractor and the respective subcontractor. The relation with a subcontractor is naturally quite capricious, but with use of the key relation indicators by Meng (2012) discussed earlier this can be made more tangible.

Project & Negotiation Level

The subcontractor management process on project level entices multiple decision moments, starting with the decision when to involve the subcontractor. This can be in the definition stage, the concept stage, during the engineering stage or after the specified design. The choice
when to involve the subcontractor is influenced by the type of subproject, type of subcontractor and the relation. The type of subproject can be determined with the segmentation scheme presented earlier (figure 2), assessing whether the goal of the project and method to achieve this goal are definable. The type of subcontractor is constrained by the characteristics of the supply market and can be determined by the segmentation scheme in figure 3. Finally, the relation can be assessed using Meng’s key relation indicators (2012). The three input variables are related to each other and have influence in the entire model.

The decision when to involve the subcontractor influences the decision to be made with regards to the type of tendering. For example, a non-critical subcontractor performing a catalogue project will be involved during the engineering or after the specified design. The type of tendering is then likely to be open and global, as this ensures a competitive offer from the subcontractors. Open and global tendering is possible because the relation with the subcontractor is not crucial and only few interactions with the subcontractor are needed to outsource the project after the specified design has been made (is mainly manufacturing).

For instance: if a subproject has a clear goal and method its typology following from the segmentation scheme is ‘catalogue’. Naturally multiple subcontractors will be available to execute this relatively simple subproject, making the supply market non-complex. Dependent on the importance of the subproject the typology will be ‘non-critical’ or ‘leverage’. This shows that the input variables are related. The question when to involve the subcontractor then becomes straightforward: since the main contractor does not need to use the knowledge of the subcontractor, it can either involve the subcontractor after the specified design has been made, or already during the engineering stage, dependent on the available resources and its relation with the subcontractor.

The bid can in this case be evaluated mainly on cost and quality, as a catalogue project is relatively easy to deliver on time and the risks can be identified and assessed by the main contractor beforehand. Finally, the type of payment/contract can be based on a fixed price, as the main contractor can make an accurate estimate of the expected costs (including risk).

The interrelatedness of the different decision moments in subcontractor management is shown in the process design and throughout the elucidation described earlier. The choices that can be made per decision moment are visualised, to inform the main contractor about the possible (non-exhaustive) choices that can be made. The relation, type of subproject and type of subcontractor are used as the input of the project level process of subcontractor management (Brockhus, 2015).
**Performance & Operational Level**

On the operational level of the process design the decisions are made that affect the day-to-day operations of the (sub)project. In the organisational structure of the main contractor the choice for collaborative tools and the performance evaluation is probably taken at a higher level, but the choice here is made to present these decisions on the level they have effect. Additionally, the input for these decisions should come from the operational level, hence the performance evaluation step.

Collaborative tools can help in supporting a productive relationship between the main contractor and subcontractor by providing insight in the progress of the project, for example. The two tools mentioned in the process design are not meant to prescribe the necessary tool but are merely meant to make sure this is taken into consideration. The main question to be asked here is what tool could help support this collaboration? Additionally, it is important to consider the impact of the collaborative tool on the relation with the subcontractor.

The performance evaluation is included in the process design because it is considered to be a vital iteration step to improve the subcontractor management process during the project, but also for future projects. The Deming Circle is not the only evaluation method one can use, but the essence is the presence of a method for evaluation, not the specific method. Finally, this feedback loop can provide input for a preferred supplier list and potentially a blacklist for subcontractors that have performed below expectation and are not willing to improve their way of working.

5. **Evaluating the process design**

Evaluation of the process design consists of three steps. First, the functioning of the process design is verified by applying the process design to the Oceanco case study. Second, by means of semi-structured interviews with project management professionals from Philips, ASML, RHDHV, Royal IHC & OVG the usability of the process design for other main contractors is investigated. The final step in evaluating the process design is to contrast the results with the relevant literature on this topic. The conclusions of these evaluation steps are presented here (Brockhus, 2015).

**Applying the process design at Oceanco**

The functionality of the process design for Oceanco proved to be bound to the complexity of the subproject: the added value of the process design was found to be larger for performance-based projects by co-makers than for catalogue projects by non-critical suppliers. This is not surprising considering that the less complex subprojects are generally easier to manage. The process design challenges the current approach Oceanco uses for its subcontractors. As opposed to the one-size-fits-all procedure Oceanco currently uses, the process design distinguishes the approach based on the complexity of the subproject and the typology of subcontractor. For the co-makers of Oceanco this approach is most flexible and contingent upon its context, as the projects these subcontractors execute are the most complex. Many challenges Oceanco currently face with the management of these co-makers can be related back to the relation between the parties. The process design emphasizes the importance of the relation and suggests an approach that incentivises Oceanco and the subcontractor to collaborate more intensively, in which flexibility for change orders is taken into account and risks are allocated towards the party that can best handle these risks.

The decision moments in the process of subcontractor management influence the project performance of the project. The relation between the output of the decision moments and the project performance criteria also reveals a relationship that is not directly visible in the process design: the influence of the determined project performance criteria on the decision moments. For example, if the focus of performance in a project is entirely centred on time, the choice for type of tendering may be predetermined to select tendering because this would save time, even if this means the costs would increase considerably. The relation between the decision moments and the project performance criteria is visualized in figure 5.

![Figure 5 Relation between decision moments and project performance criteria](image-url)
First, the process design shows that there are multiple ways to manage a subcontractor successfully. It follows the thought that project management should be made contingent based on its content (Bosch-Rekveldt, 2011). The process design therefore allows for flexibility, as there is no single ideal procedure to approach a particular problem (De Brujin, ten Heuvelhof, & in ’t Veld, 2010). The deliberate choice was made to make the process design the abstract enough to allow main contractors to make an informed decision themselves. Besides, in subcontractor management some discretionary room is needed to adequately deal with the complexities of specific subprojects and characteristics of specific subcontractors, instead of being mauled through an inflexible procedure (Brockhus, 2015).

However, it is recognized that the process design could be equipped with more steering on which subcontractor management approach to follow in which situation. Additionally the concerns of Oceanco about the easiness to use the process design are taken seriously, as the process design is meant to allow main contractors in making the subcontractor management decisions themselves. In the end they will be the end-users of this process design. The process design intends to function as a canvas for main contractors in creating their subcontractor management strategy per subproject. A parallel can be drawn here with the Business Model Canvas, which challenges entrepreneurs in thinking of all relevant steps of a successful business plan. However, in its current state the process design does not provide an example on how this canvas should be filled in by the main contractor. Additionally, the process design cannot be used as stand-alone tool, as the input variables are not specified in the process design, but explained by segmentation schemes separately.

Therefore, the effort has been taken to transform the process design into a canvas that offers more guidance in the management approach to choose and is easier to use as stand-alone tool by project management professionals. This canvas makes use of the same ingredients as the process design. The segmentation schemes of type of subproject and type of subcontractor, as well as the overview of Meng (2012)’s key relation indicators, are included in this canvas. Additionally, the input variables are assigned with an icon, which is placed throughout the canvas to provide the user with more guidance about which approach to follow. For instance: the decision when to involve the subcontractor for a blue sky subproject is advised to be in the definition stage or the concept stage. The result of filling out this canvas is shown in figure 6.

The main added value of this subcontractor management canvas is that it immediately provides more insight in which approach to follow, founded on the three input variables of type of subproject, type of subcontractor and relation.

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**Interviews with project management professionals**
The interviews were held to explore the usability of the process design outside of the Oceanco organisation (Brockhus, 2015). Although the process design was founded on the empirical data from a single case study (combined with relevant academic literature), the process design seemed also applicable for other main contractors.

In general, the interviewed project management professionals were satisfied with the completeness of the process design. The feedback of the professionals on the process design was similar to the feedback received by Oceanco’s executives (Brockhus, 2015). The interviewees had some critique with regards to the level of steering in the process design: the design was missing an advisory function. The discussion elaborates more upon this trade-off between the level of steering and the applicability of the process design. Additionally, some interviewees argued that the influence of risk was not emphasized enough in the process design. Indeed, the influence of risk is recognized to be of the essence in subcontractor management, as subcontractor management in abstract terms can be seen as the management of allocated risk. Therefore in the process design risk is included as one of the key relation indicators, as one of the evaluation criteria and inherently coupled to the typology of both the subproject and the subcontractor. Risk is implicitly present in the entire model, but could have been mentioned explicitly more often. Risk analysis could for example also be used as an input for the model.

**Contrasting the process design with literature**
The process design does not really contradict literature; it merely integrates several views in literature on subcontractor management. This is because it is argued that subcontractor management should be adapted upon the subproject’s context. The main thought behind the process design is similar to the academic theory on process management, which argues that there is no unambiguous substantive solution that holds for every situation (De Brujin, ten Heuvelhof, & in ’t Veld, 2010). The emphasis in the process design is put on the behavioural aspects of subcontractor management (Bosch-Rekveldt, 2010; Engwall, 2003; Howel, Windahl & Seidel 2010; Sauser et al 2009; Shenhar, 2001; Smyth & Morris, 2007; Williams, 2005), complemented by traditional tools and techniques targeted at complete control in project management (Project Management Institute, 2008).

6. **Subcontractor management canvas**
The main point of feedback on the process design during the evaluation was the lack of guidance in the model. The feedback gathered during the evaluation provided interesting material for discussion and iteration of the process design.
1. **When to involve Subcontractor**
   - Definition Stage
   - Concept Stage
   - Engineering Stage
   - After Specified Design

2. **Type of Tendering**
   - Open
   - Closed
   - Global
   - Local
   - Selected

3. **Bid Evaluation**
   - Cost
   - Quality
   - Time
   - Risk

4. **Type of Contract / Payment Scheme**
   - Fixed Price (+ incentive fee)
   - Cost + Fixed Fee / Cost + Incentive Fee
   - Guaranteed maximum & share savings
   - Reimbursable

5. **Collaborative Tools**
   - What is needed?
   - Primavera
   - Punchlist

6. **Performance Evaluation**
   - Plan
   - Act
   - Check
   - Do

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<th>Relation with Subcontractor</th>
<th>Mutual objectives</th>
<th>Pain &amp; Gain sharing</th>
<th>Trust</th>
<th>No-Blame culture</th>
<th>Performance measurement</th>
<th>Communication</th>
<th>Problem solving</th>
<th>Risk allocation</th>
<th>Joint working</th>
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<td>Framework Agreement</td>
<td>All projects</td>
<td>Specific projects</td>
<td>+ # hours/volume</td>
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To analyse whether this subcontractor canvas adequately responds to the concerns expressed by Oceanco and the project management professionals, the subcontractor management canvas was discussed with Oceanco. Instead of presenting the filled canvas, a workshop was organised in which multiple project managers and purchase managers were asked to fill out the canvas from their own perspective following the same methodology as previously described: with one input variable at the time. This ensured that the discussion on the suggested approach was postponed to the moment that the canvas was completed.

Some differences in perspectives on the best management strategy were observed during the presentations given by the participants. As subcontractor management is largely based upon personal preferences, interactions and tacit knowledge, this is only considered to be a natural phenomenon. The differences triggered a discussion on which subcontractor management approach to follow in which situation; the ideal outcome as it apparently challenged the participants to think about their subcontractor management strategy. Eventually this is the ultimate goal of the canvas: make the main contractor think about its subcontractor strategy and enable them to make an informed decision.

The subcontractor management canvas was constructed based on the feedback of Oceanco. Although the feedback of the project management professionals was similar, the model could not be validated by means of workshops with these professionals because of the limited timeframe for the research. This could however be very interesting for future research.

7. Conclusion

Effective subcontractor management approaches are highly circumstantial, because there is no such thing as a one-size-fits-all solution to subcontractor management. The most important variables influencing the subcontractor management approach are the relation, the type of subproject and the type of subcontractor. Naturally the most complex subprojects are hardest to manage, especially if the supply market characteristics are also challenging. However, the largest gains considering subcontractor management can also be made in these situations.

Subcontractor management takes place at multiple levels of the organisation of the main contractor; it exceeds the project boundaries and is largely influenced by previous interactions, as well as potential future interactions. The relation with the subcontractor influences the negotiation, which will subsequently influence the project (performance). Subcontractor management therefore requires an integrated approach, in which the feedback from the operational to the strategic level of the organisation a precondition is for improvement.

The process design was found to be a valuable tool for project management professionals, as it gives a comprehensive and complete view on the process of subcontractor management. Furthermore, the input variables were considered to be useful. Especially the segmentation of type of subproject was found to largely influence the subcontractor management strategy. The complexity of the subproject can easily be determined by assessing the goal of the subproject and the method to achieve this goal. The most complex type of subproject has neither a clear goal nor a definable method. For such subprojects the main contractor has to rely heavily on the expertise of the subcontractor.

Two aspects are very important considering this type of subprojects: the relation with the subcontractor and the allocation of risk. The main contractor will only give the necessary freedom for the subcontractor to excel if there is trust between both parties. Here the key relationship indicators can be used to assess the relationship and identify possible directions for improvement. Additionally, the risks associated with these subprojects should be assessed together with the subcontractor before the subproject is executed and transferred to the party that can best handle this risk. Performance-based contracts can be used to give the subcontractor the right incentive to excel in its performance and allocate this risk to the right party.

The interviewed project management professionals missed some guidance and steering on which subcontractor management approach to use in each situation. Furthermore the process design was argued to be insufficiently detailed to be used as a stand-alone tool. This mainly related to the lack of explanation on the input variables in the process design.

The subcontractor management canvas that was created as response to the feedback on the process design was received well within the organisation of the case study Oceanco. The canvas can be used as stand-alone tool and includes several suggestions on the subcontractor management approach to follow. Additionally, the workshop in which the canvas was interactively presented evoked discussion and led the participants thoroughly think about their subcontractor management strategy.

Although the canvas was constructed based on the feedback of project management professionals from several industries, their opinion on the subcontractor management canvas could not be investigated due to the limited time frame of the research. The proven value of the canvas for the present is therefore limited to the case study of Oceanco, which leaves the scientific value open for future research. The scientific value of the canvas can be improved through additional interviews and/or workshops. Considering the potential of the canvas such future research is recommended.
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