ABSTRACT

There are a number of different parties involved in the processes for realization of building projects. A good collaboration between those partners is very important in order to achieve an optimal building process. This research project is focused on the collaboration between two important parties: the contractors and sub contractors. The aim of the research is to enlarge the efficiency of the building process by improving the quality of the collaboration between these two parties.

The research method is based upon the Quality Function Deployment, which provides a systematic approach for meeting the customer’s needs. Both contractors as well as sub contractors are in this research approach regarded as customers and suppliers, receiving goods and services form each other during the construction process. Both groups in this research are asked to judge from their point of view of ‘clients’, the performances delivered by their ‘suppliers’.

The research program contains three major steps. First an adequate instrument is developed to represent and measure performances of collaboration. The instrument, in terms of a dedicated questionnaire consists of 31 different variables or ‘components’. In the next step this instrument is used to measure recent performances of collaboration between contractors and sub contractors in the Netherlands. For this purpose a large group of experts from contractors and subcontractors has been asked for contributions. The response group was large enough to obtain a qualitative representation of the contractors and subcontractors of the Dutch building industry. The results of this phase in the research project provide data for identifying the specific aspects of collaboration that need improvement. Both the measurement of each variable as well as the ranking of each variable in a list are presented.

KEYWORDS:
Contractor; Subcontractor; Collaboration; Performance

INTRODUCTION

Collaboration is often discussed and addressed in many occasions in construction projects. Many definitions of collaboration can be observed and in fact all these definitions refer to different aspects of this comprehension. In this project a serious attempt has been made for an objective approach towards the complex nature of collaboration between different parties of construction projects in the Netherlands. By means of this approach a specific section of collaboration has been measured as well: the collaboration between two important parties. The results of this research project are presented in this article. First a short explanation about the situation in the Netherlands is given in chapter 2 and then the research approach is explained in chapter 3. The combination of different data fields in section 4.4 is in fact summarizing the aspects of collaboration that are well appreciated and aspects which need to be improved.
DEVELOPMENT OF THE CONSTRUCTION PROCESS IN THE NETHERLANDS

During the last decade the relations between the contractors and the subcontractors has influenced by the changing of the nature of the construction process. This change is the result of a construction process which more and more has been rationalized based upon industrialized production techniques. Not only contractors and subcontractors in a traditional setting were involved in the complex process of cooperation, but also consultants and suppliers have been claiming a more active role in the cooperative construction process. Although in many cases the contractor is still leading partner in the process by means of the contract agreements, in practice this process is controlled by the possibilities of cooperation between all of the parties involved. At present in the Netherlands the demand for production capacity for developing new buildings is rather high and more and more clients are faced with rather ‘strong’ prices and a lack of possibilities for production. The amount of production raised by the main contractor is decreasing, while the production delivered by the specialized sub contractors and supply industry is increasing. In other words a growing part of the added value of the production on site is delivered by sub contractors and supply industry and so a good cooperation between those parties becomes more and more important.

INVESTIGATION OF THE COLLABORATION DURING THE BUILDING PROCESS

There are a number of different parties involved in the building process, as mentioned already in the proceeding paragraph. The tuning of these parties is an important factor for the progress of the building process. In general the research aims to achieve improvement of the collaboration between the mentioned parties. The first major step however is to explore and identify the problematic aspects concerning collaboration during building process. This means that the major concern of this research project is to investigate the difficulties of the collaboration between contractors and subcontractors of the building process in the Netherlands. For this purpose an analysis is made of the concept of ‘collaboration’ and than a research methodology has been chosen for investigating the problems concerning collaboration during the building process.

Analysis of the concept of collaboration in construction

Collaboration is a complex concept dealing with things like understanding, trust, contracts and a search for individual profit. In this research project the definition of the concept of collaboration has been made operational by making an inventory of all the aspects mentioned about collaboration by a selected group of respondents from the building practice. In this way a list of ‘components’ good be constructed, which is as a whole, a broad representation of ‘collaboration’. The basis for this phase of the research was given by a list of ten points of problems that was concluded from an earlier research project in the Netherlands, executed by the Dutch Foundation of Building Research [SBR, 1995]. These ten items can be listed as follows:

1. the pressure of time is to high and the planning suffers inadequacy
2. the purchase activities of main contractor are to much focused on getting the lowest price and are not searching for possibilities for making a maximal benefit out of the qualities offered by the sub contractor
3. the ‘culture’ of the contractor companies are focused on technical aspects of construction and to few attention is given for management qualities and communication
4. many ‘deals’ and changes of those ‘deals’ and expected responsibilities are not made explicit by means of a some kind of formalized and written contracts
5. the client changes his demands during the process of construction
6. there is no sufficient structure for consultations of the parties involved during the building process
7. procedures concerning quality management systems and concerning safety management and environmental protection are difficult to maintain during the process and are inadequately linked
8. the project organization and evaluation of the project progress is troublesome and the expertise of the project manager and site manager on the aspect of logistics is poor and
therefore problems concerning the stagnation of the production on site are not recognized in time

9. during the preparation of a new construction process sufficient use is been made of the practical experiences and knowledge of site managers
10. the work force of sub contractors is changing to often

TABLE 1. The Concept of Collaboration described by 31 components.

<table>
<thead>
<tr>
<th>CONTRACT PHASE</th>
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<tbody>
<tr>
<td># 1 The quality of the data given by the contractor to the sub contractor for bidding</td>
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<tr>
<td># 2 The period of time given by the contractor to the sub contractor to accomplish the process of bidding</td>
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<tr>
<td># 3 The willingness of the contractor to address the idea’s and wishes of the sub contractor during the contract negotiations</td>
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<td># 4 The amount of ideas of the sub contractor during the contract negotiations</td>
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<tr>
<td># 5 Making clear statements of the appointments made during the contract negotiations of the project</td>
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<tr>
<td># 6 The management skills of the contract negotiators of the contractor</td>
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<tr>
<td># 7 The management skills of the contract negotiators of the sub contractor</td>
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</tbody>
</table>

<table>
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<tr>
<th>THE WORK PREPARATION PHASE</th>
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<tr>
<td># 8 The quality of the work preparation data delivered by the contractor to be used by the sub contractors</td>
</tr>
<tr>
<td># 9 The quality of the work preparation data delivered by the sub contractor to be used by the contractors</td>
</tr>
<tr>
<td>#10 The given amount of time to elaborate the preparation of the work on site</td>
</tr>
<tr>
<td>#11 The willingness of the contractor to adapt ideas of the sub contractor during the work preparation</td>
</tr>
<tr>
<td>#12 The amount of ideas of the sub contractor during the work preparation</td>
</tr>
<tr>
<td>#13 The quality of the preparation of the project, done by the contractor</td>
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<tr>
<td>#14 The quality of the preparation of the project, done by the sub contractor</td>
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<tr>
<td>#15 Matching the activities on the planning of the contractors with the activities on the planning of the sub contractors</td>
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<tr>
<td>#16 Making clear statements of the appointments made during the work preparation</td>
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<tr>
<td>#17 The management skills of the negotiators of the contractor during the work preparation</td>
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<tr>
<td>#18 The management skills of the negotiators of the sub contractor during the work preparation</td>
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<table>
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<tr>
<th>THE EXECUTION PHASE</th>
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<tbody>
<tr>
<td>#19 The feasibility of the project planning of the contractor</td>
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<tr>
<td>#20 The feasibility of the project planning of the sub contractor</td>
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<tr>
<td>#21 The knowledge and experience of the managers of the contractor</td>
</tr>
<tr>
<td>#22 The knowledge and experience of the managers of the sub contractor</td>
</tr>
<tr>
<td>#23 The management skills of the project managers of the contractor during the execution phase</td>
</tr>
<tr>
<td>#24 The management skills of the project managers of the sub contractor during the execution phase</td>
</tr>
<tr>
<td>#25 The periodical evaluation of the progress of the on site project activities</td>
</tr>
<tr>
<td>#26 The willingness to solve problems together</td>
</tr>
<tr>
<td>#27 The willingness of the contractor to refer to agreements with the sub contractor</td>
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<tr>
<td>#28 The willingness of the sub contractor to refer to agreements with the contractor</td>
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<tr>
<td>#29 The amount of a collective ‘team spirit’</td>
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</table>
THE DELIVERY PHASE

<table>
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<tr>
<th>#30</th>
<th>How well is the desired quality described by the client</th>
</tr>
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<tbody>
<tr>
<td>#31</td>
<td>How well has the desired quality been realised</td>
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</table>

This list of top ten problems concerning collaboration in the building process are rather representing a global view on the concept of collaboration and the points that were listed are in many cases combinations of two or more sub problems. However this list served well as a set of stimuli for the interviews with a group of experts from the building practice.

After an iterative process of interviewing and having discussions with these respondents about the list of top ten problems a complete set of 31 items was attained. These items were defined as the components representing together the complex concept of collaboration. Each of these components represents a potential problem concerning the cooperation between contractors and sub contractors. Another result that came out of this phase of the research project was that the components good be ordered to four consecutive phases of the building process. This large set of components with its structure of four phases is shown in table 1.

Measuring the quality of collaboration between contractors and sub contractors

In the proceeding section of this publication a definition of the concept of collaboration has been given by means of a representation of 31 components. To measure cooperation between contractors and sub contractors in this research project the ‘Quality Function Deployment’ method (QFD) was used. This method makes it possible to identify and measure customer’s needs. Essentially, customers are those impacted in any way by a product. Every participant in the construction process can therefore be portrayed as a customer whether they are owner, designer, contractor, sub contractor or constructor (Mallon J.C. & Mulligan D.E.). Both contractors and sub contractors are regarded as each other’s clients. Based upon this view the QFD method has been adapted and slightly changed in this research project.

In general the results that will come out will describe how the contractors ‘appreciate’ the cooperation with sub contractors and visa versa. Also a ranking will be presented of aspects of cooperation that are selected for improvement: both by contractors and sub contractors.

In fact two combined parallel research activities can be distinguished in this project. One project regarded the sub contractors as customers of the products of the contractors. The other research regarded the contractors as customers of the products of the sub contractors. The notion of ‘products’ is interpreted as the delivered quality concerning collaboration by contractors as well as by sub contractors during the building process. The results of the two investigations could be compared.

The following research steps according to the QFD method can be distinguished:

a. identify the customer needs
b. evaluate the importance
c. evaluate existing situation
d. consider the competition
e. define the sales point or market value

These research activities could not all be applied in this research project (Bax & Bruning, 2000). There was no question of validating the position of one company, but the survey in this research was done for a group of companies, that was representative for the Dutch construction branch. For this reason the steps “d” and “e”, parts of the complete QFD approach, were not implemented in this project. The implementation of the method was done as follows:

Ad a. For the identification of the customers needs the set of 31 components of collaboration was applied (see table 1). In the proceeding section ‘Analysis etc.’ is explained that the mentioned set of descriptions were developed by interviewing professionals, ‘the customers’, working in the field of
construction practice. Each of these 31 components that came out of the interview sessions can in fact be considered as ‘a subject that needs attention in the negotiations between contractors and sub contractors’. Therefore each component can be used as an identifier for ‘a need of a customer’.

Ad b. For the evaluation of the importance of each of the 31 components the two groups of representatives of the contractors and subcontractors were asked to choose a value expressing the importance of each component. Four values were possible, “1”, “2”, “3”, and “4”, expressing a range from “unimportant” to “important”. By offering an equal number of possibilities the respondents were not able to choose for a neutral point of view. Next they were asked to identify the importance of each of the four building phases, also using the values “1”, to “4”. The weight of each component was calculated by the formula:

\[ W = \frac{V_c \times V_{ph}}{4} \]

\( W \) = Weight of component; \( V_c \) = value component; \( V_{ph} \) = value of building phase

Ad c. evaluate existing situation

For this purpose the respondents were asked to derive their opinions about each of the components by judging one of the present projects their own company was working on in collaboration with either contractors or subcontractors. Their judgment concerning each of the 31 components could also be expressed according to four classes: “1” as bad, “4” as good.

RESULTS OF THE RESEARCH PROJECT

The data was collected by questionnaires that had to be filled in by selected respondents. The questionnaires were developed based on the set of components, shown in table 1. In total 152 sets of questionnaires were filled in and returned. The respondents were in number more or less equally representing contractors and subcontractors in the Netherlands.

Ranking the 31 components of collaboration by importance

In this publication only the top five of the ranked components are represented. The responses of the contractors resulted in a ordering where the “top seven” were identified as the following components:

1. (#26) The willingness to solve problems together
2. (#13) The quality of the preparation of the project, done by the contractor
   (#16) Making clear statements of the appointments made during the preparation of the work
3. (#8) The quality of the work preparation data delivered by the contractor to be used by the subcontractors
4. (#14) The quality of the preparation of the project, done by the sub contractor
5. (#9) The quality of the work preparation data delivered by the sub contractor to be used by the contractors
   (#29) The amount of collective ‘team spirit’
6. (#19) The feasibility of the project planning of the contractor
   (#28) The willingness of the sub contractor to refer to agreements with the contractor
7. (#27) The willingness of the contractor to refer to agreements with the sub contractor

Responses of the subcontractors resulted in a different list of “top seven” components of main interest.

1. (#27) The willingness of the contractor to refer to agreements with the sub contractor
2. (#13) The quality of the preparation of the project, done by the contractor
   (#15) Matching the activities on the planning of the contractors with the activities on the planning of the sub contractors
   (#26) The willingness to solve problems together
   (#28) The willingness of the sub contractor to refer to agreements with the contractor
3. (#29) The amount of collective ‘team spirit’
4. (#14) The quality of the preparation of the project, done by the sub contractor
   (#20) The feasibility of the project planning of the contractor
5. (#16) Making clear statements of the appointments made during the preparation of the work on site
   (#19) The feasibility of the project planning of the contractor
6. (# 8) The quality of the work preparation data delivered by the contractor to be used by the sub contractors
   (#22) The knowledge and experience of the managers of the sub contractor
7. (# 5) Making clear statements of the appointments made during the contract negotiations of the project

Most of the components that are shown on the list of the contractors can also be found on the list of the sub contractors. However the ranking of the components is slightly different. In general both group of respondents have apparently much in common when they are asked to indicate the subjects that sub contractors and contractors ‘should’ concern to be of most importance for collaboration. The selected components also indicate that the process phase ‘Work Preparation’ and the process phase ‘Work Execution’, respectively phase 2 and 3 of the building process mentioned on table 1, are considered to be the most important for addressing problems with collaboration between contractors and sub contractors.

The evaluation of present existing situations
Again it should be noticed that the presented lists in this section are the results of calculating the mean value of 152 responses. The measuring of the ‘present’ collaboration resulted in the following lists for the contractor’s and sub contractor’s judgments. The first list shows the “top three” of good experiences with present cooperation and the second list shows the “top three” of bad experiences of the contractor.

A(1) Good present experiences of the contractor:
1. (#21) The knowledge and experience of the managers of the contractor
   (#26) The willingness to solve problems together
2. (#27) The way the contractor is keeping up the appointments made during the contract negotiations of the project
3. (# 3) The willingness of the contractor to address the idea’s and wishes of the sub contractor during the contract negotiations

A(2) Bad present experiences of the contractor:
1. (#10) The given amount of time to elaborate the preparation of the work on site
2. (#20) The feasibility of the project planning of the contractor
3. (#25) The periodical evaluation of the progress of the on site project activities

The judgments of the sub contractors resulted in the following two lists:
B(1) Good present experiences of the sub contractor:
1. (#26) The willingness to solve problems together
2. (#28) The way the sub contractor is keeping up the appointments made during the contract negotiations of the project
3. (#27) The way the contractor is keeping up the appointments made during the contract negotiations of the project

B(2) Bad present experiences of the sub contractor:
1. (#19) The feasibility of the project planning of the contractor
2. (#10) The given amount of time to elaborate the preparation of the work on site
3. (#25) The periodical evaluation of the progress of the on site project activities

It is very interesting to observe that component (#26) “The willingness to solve problems together” is addresses as very important both by contractors and sub contractors. And it is also very positive to find that this component is also very well appreciated in the actual practice of building projects. Although component (#10) “The given amount of time to elaborate the preparation of the work on site” was not indicated on the list of “top seven” components of main interest in one of the previous sections, neither by the contractors, nor by the sub contractors, this component was found to be rather troublesome in the present building practice.
The overall appreciation of the present collaboration

Based on the figures derived from the 152 responses (see the introduction of this chapter), the mean values for the appreciation of the collaboration have been calculated. For the contractor’s and the subcontractor’s appreciations mean values were found of respectively 3.09 and 3.34 on a scale of 1 to 4. This means in other terms that contractors were found to be 69.7% satisfied with the actual collaboration in their present building projects. The subcontractors appeared to be more content: their mean appreciation for present collaboration was 78%. Looking at these two figures one can conclude, that the overall appreciation of the present collaboration is rather well.

Presenting the priorities for improvement

A complete view over the combined results is given in this section. The ranking of components to the aspect of importance is explained in the previous section ‘Ranking… by importance’. Within the limited scope of this paper only selections of significant groups of components were given. This has also been done in section ‘Appreciation… existing situation’, where the appreciation for each component in present practice has been summarized. The result of these two sets of observations has been used to indicate the need for improvement for each component. The importance of the components as indicated by both groups of respondents is shown in the chart diagram of figure 2.

Figure 2. QFD Results. For each component the relative need for improvement is shown, by the subcontractors as well as by the contractors.

For each component a value is given indicating the size of its ‘problem’. The numbers in figure 2 also show the problem gaps between sub contractors and contractors. For the calculation of the presented values the following formula has been applied:

‘Problem size’ = (Importance see section 4.1) * (Best value – Appreciation see section 4.1.1)

Best value is 4, which is the highest possible appreciation value for each component, in the context of this research.

Both the contractors and the subcontractors indicate different priorities, as is shown in figure 2, for improvement of the collaboration between those two parties during the building process. This calculated combination of ‘importance’ and ‘appreciation’, expressed in terms of ‘Problem size’ results to the following priorities for improvement:

For the contractor:
CONCLUSIONS AND DISCUSSION

Significance A period of more or less six month was necessary to complete this research project. Approximately five hundred questionnaires were sent to employees of construction companies, contractors as well as sub contractors. The researchers asked for this purpose the cooperation of departments of building engineering of a number of polytechnic universities to select addresses. In this way the questionnaires were sent by ‘direct mail’ to specified contacts. The response was not bad: 152 forms were returned. It is difficult to calculate the significance of that response in a quantitative way. By evaluating the backgrounds of the respondents, the companies they represented and so on, the researchers concluded that their representation was satisfying at least in a qualitative way.

A lack of adequate planning The lessons to be learned from this investigation are not yet available. It is interesting to observe how contractors and sub contractors have different opinions about how troublesome each component of collaboration is from their point of view. The overall value for ‘collaboration’ is not bad; the figure given in section ‘Overall appreciation,’ is convincing positive. However some major directions for solutions can be distinguished. “The willingness to solve problems together” is addresses as very important both by contractors and sub contractors. And it is also very positive to find that this component is also very well appreciated in the actual practice of building projects. The given amount of time to elaborate the preparation of the work on site and the feasibility of the project planning of the contractor are regarded as troublesome both by the contractors and sub contractors. Apparently for many projects possibilities and abilities for planning the work in good order are not available. Many parts of production on site remain somehow uncertain and thereby deliver serious problems for establishing a good collaboration.

Meta results The first phase of this research project resulted in a generic description of the complex concept of ‘collaboration’. Now this description is available for similar investigations in other countries. It would be very interested to observe collaboration in this way in different countries and investigate the differences between the appreciation of collaboration in one country and another. Within this perspective the explained results in this article will have one more value as well.

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