

MAIN FACTOR IDENTIFICATION FOR EARLY NEGOTIATION IN PRODUCT DESIGN

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ABSTRACT

In organizational markets (B2B markets), the buyer and supplier companies often work together as collaborators in the context of an extended enterprise. As such a collaboration involves signing a contract which implies potentially long-term commitment by both sides, it is important to make a global estimation during the phase “early negotiation”, where design specifications directly from buyer needs are defined.

Although the early negotiation phase greatly impacts the overall buyer and supplier results, to the best of our knowledge, no framework has been proposed to define what factors should be considered during such an estimation.

In this study, we first propose the definition and process of the phase “early negotiation”, where the engineering design steps which help the supplier to estimate buyer requirements satisfaction are identified. Then a framework is proposed to tell both buyer and supplier what factors should be estimated under different contexts.

This framework was developed after an extensive literature review and observations. It aims at providing early decision support for companies and methodology development guidance for researchers.

Keywords: product design, early design phases, design process, main factors

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1 INTRODUCTION

Nowadays the supplier companies and buyer companies in organizational markets (B2B markets) tend to work as collaborators in the context of an extended enterprise. This working manner allows integrating specific needs of the buyer into the product design thus increasing the satisfaction of buyer requirements. However, this closer collaboration makes the matching between companies more important and contract signing more delicate.

The early negotiation phase in organizational markets is the period before contract signing between the buyer company and supplier company. This phase aims at evaluating the compatibility among the design project, the buyer organization and the supplier organization, and transforming buyer needs into design specifications in form of a contract. Before signing the contract, a series of factors should be considered, evaluated or estimated in order to reduce risk.

Numerous previous studies have identified factors to be considered during this stage, but they all only consider the viewpoint of the buyer or supplier in isolation and most of them are limited to particular contexts. In this study, we propose a framework which identifies the main decisional and contextual factors from the viewpoints of both the buyer and supplier. Based on the basic correlations identified between decisional and contextual factors, companies can customize the framework according to their own needs and use it to identify main factors in various negotiation contexts. This framework was developed after an extensive literature review and observations. It aims at providing early decision support for companies and methodology development guidance for researchers.

In the following sections, chapter 2 is dedicated to related works, while chapter 3 is used to define the early negotiation stage. In chapter 4, the main factors are identified and the framework is proposed and illustrated by an example. Finally, a conclusion is given in chapter 5.

2 RELATED WORKS

In the early negotiation stage, the buyer company has two decisions to make: firstly, should the product be designed within the company or outsourced? Secondly, which supplier should be chosen to outsource the product design to? Answers to these two questions concern the outsourcing decision factors and the supplier selection factors. On the other hand, the supplier is in charge of carrying out the product design and finally delivering the product. Therefore the supplier is interested in the success factors for R&D projects and success factors for new product development. A sample of key references concerning success factors for R&D projects, success factors for new product development, supplier selection factors and outsourcing decision factors is listed in Table 1.

A large number of factors were discovered during the literature review. However, most of these factors are constrained by particular viewpoints or contexts (for example success factors for technological entrepreneurs' R&D projects) and we were unable to find a general framework for the identification of factors.

3 DEFINITION OF THE EARLY NEGOTIATION STAGE

We first propose a definition of the early negotiation stage integrated into organizational markets, since we did not find such a definition in previous studies.

Two different processes are observed simultaneously in this stage: the organizational buying process and the engineering design process. We investigated the two processes and analyzed relations between their steps. As a result, the process of the early negotiation stage is defined and the engineering design steps during this stage are identified.

3.1 Organizational Buying Process

The best known model for organizational buying process is the idea of “buy-grid” developed by (Webster & Wind 1972) and (Robinson et al. 1967). This framework divides the buying situation into “new task purchase”, “modified rebuy”, and “straight rebuy”. Among the three, the new task purchase is the longest process, and the processes of the other two types can be seen as simplified thereof. The general process for the new product purchase is detailed in Figure 1.

Table 1 Related works for main factor identification in early negotiation

Category	Article	Relevance to the topic
Success factors for R&D projects	(Balachandra & Friar 1997)	Reviewed 60 papers of success factors including marketing, technological, environmental, and organizational factors; Identified 14 most important factors out of 72; Found that the magnitude and the direction of the factors both vary depending on the context.
	(Astebro 2004) (Astebro 2003)	Studied 561 R&D projects; Identified 4 most important factors out of 36.
	(Millier 2005)	Proposed 4 groups of conditions and 3 categories of factors for the success of an innovative project.
	(Cooper 1981)	Analyzed variables which should be included in the scoring model of R&D project selection, 7 factors were found more important than the others; Studied weights for each variable.
Success factors for new product development	(Udell 1989)	Reviewed and analyzed factors for technical evaluation programs for inventions.
	(Daniel et al. 2007)	Selected 15 factors to support the method which predicts the success of products in the market.
Supplier selection factors	(Ho et al. 2010)	Identified the criteria which were paid more attention to in supplier evaluation and selection.
Outsourcing decision factors	(Padillo & Diaby 1999)	Proposed strategy, operation, and finance criteria for a multiple-criteria decision methodology for the outsourcing problem.
	(Platts et al. 2002)	Investigated the factors other than cost which affect outsourcing decisions.

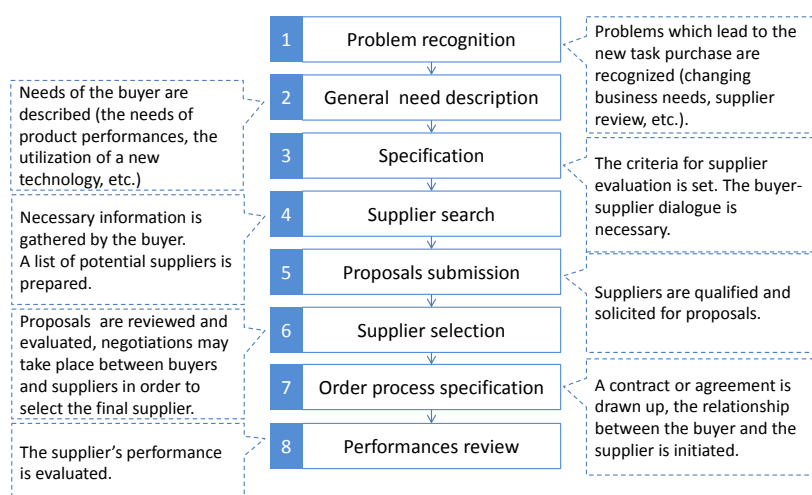


Figure 1 Organizational buying process for new task purchase, adapted from (Wright 2004)

The process shown above is a general process for the new task purchase, in which the buyer will purchase a product for the first time. The buyer has very little experience with the capabilities of the supplier and with the performance evaluation of the product.

In a modified rebuy, the buyer has some experience of the product or service, but this kind of purchasing always requires a certain degree of customization, such as in product specification, price or delivery time. In this kind of purchase, step 4 can be omitted.

In a straight rebuy, the buyer purchases the product without any modification. However, the supplier may also suggest the buyer to use a more suitable product. This kind of purchase happens mostly for basic goods such as office supplies. In this type of purchase, steps 1 and 2, and quite possibly steps 4 to 7 can be omitted (Wright 2004).

3.2 Engineering Design Process

The engineering design process is carried out by the supplier company since we assume that the supplier is in charge of product development.

According to the literature review of (Ogot & Okudan-Kremer 2004), the engineering design process is normally composed of 5 phases (as shown in Figure 2) with slightly different steps in each phase according to different authors. It is noteworthy to mention that the engineering design is usually an iterative process; most of the steps have to be repeated. This is not represented in Figure 2.

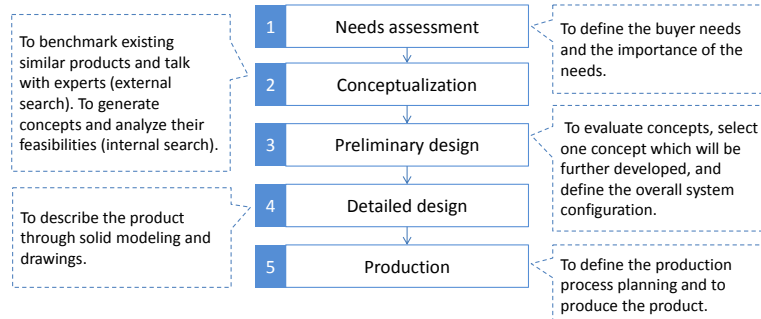


Figure 2 General engineering design process, adapted from (Ogot & Okudan-Kremer 2004)

3.3 Proposition of Definition for the Early Negotiation Stage

The main objective of early negotiation is to transform buyer requirements into design specifications in form of a contract. Therefore, we focus on the period between these two milestone events when defining the early negotiation stage. By investigating the steps in the two processes, we propose a process for the early negotiation stage as shown in Figure 3.

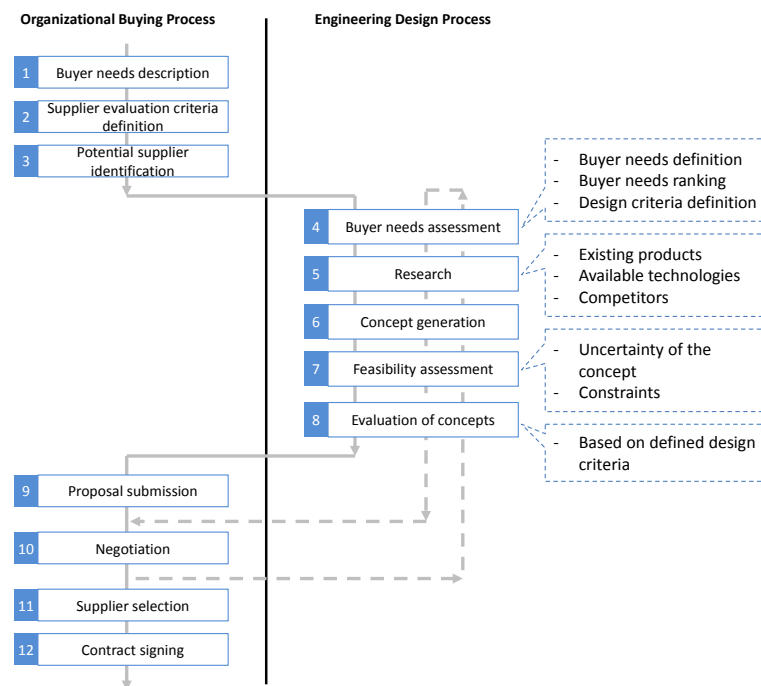


Figure 3 Process of the early negotiation stage

We define the early negotiation stage in organizational markets as the period between the description of buyer needs by the buyer and the definition of design specifications in form of a contract by the buyer and supplier. This phase is related to organizational markets (B2B markets) where the buyer and supplier are collaborators in the context of an extended enterprise. The supplier in this case has to gather product data, identify the feasibility of the product and respond to the requirements of the buyer. Several engineering design steps should be rapidly carried out to support the negotiation. Since engineering design is an iterative process, the steps will normally be repeated after the contract is signed.

4 MAIN FACTOR IDENTIFICATION

We found that two types of factors are necessary to represent the main factors during early negotiation. The first type describes the context of negotiation which we call “contextual factors”, and the second type, which contains factors that should be considered, evaluated or estimated, are called “decisional factors”. Since all previous studies have proposed important factors from either the buyer’s or supplier’s point of view, in the first part of this section we follow this pattern to collect main factors from buyer and supplier individually.

We then show that since some of the factors from the two viewpoints are similar, the factors can be regrouped from a point of view which represents the interests of both the buyer and the supplier.

Finally, according to previous research, we propose to identify correlations between decisional factors and contextual factors. Companies can also modify the correlations according to their own opinion to obtain a customized framework. For a particular negotiation, specific contextual factors are selected and the correlated decisional factors are defined as main factors.

4.1 Main Factors from the Viewpoint of the Supplier

The factors interested by the supplier are success factors for R&D projects and success factors for new product development as shown in related works.

For contextual factors, (Balachandra & Friar 1997) found that the following 3 affect success the most in R&D projects and new product innovation: innovation (incremental, radical), technology (high, low), and market (existing, new). (Millier 2005) pointed out the effect of innovation type on factor selection; he divided innovation into the 4 types: ordinary innovation (with little technological or commercial breakthrough), revolutionary innovation (with technological breakthrough), niche-creating innovation (with commercial breakthrough), and the radical innovation (with both technological and commercial breakthroughs). In addition, (Udell 1989) argued that small businesses/inventors should be distinguished from big corporations.

In reality, possible architectures proposed by the supplier may not share the same innovation and technology level, so these two contextual factors cannot be predefined. Therefore we propose to consider only supplier and market type as contextual factors, as shown in Figure 4.

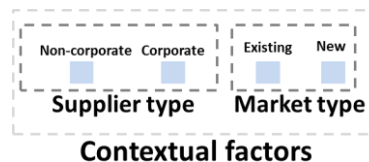


Figure 4 Proposition of contextual factors from the viewpoint of the supplier

For decisional factors, we divided the factors found into 4 categories: nature of the product, project/company fit, market opportunity and societal factors, as shown in Table 2.

In order to generate a manageable list, we selected the factors which are generally agreed by the authors. In addition, the factors which are too difficult (if not impossible) to evaluate or estimate are omitted, such as management support level, internal concurrence, commitment of project staff etc.

4.2 Main Factors from the Viewpoint of the Buyer

The factors of interest to the buyer are the supplier selection factors and the outsourcing decision factors as shown in related works.

For contextual factors, (Hutt & Speh 2012) pointed out that classifying organizational buyers is an important first step to a sharpened understanding of the buying criteria. Furthermore, the type of goods purchased may also influence the marketing pattern of organizations. (Blythe & Zimmerman 2005) found that buying situations may affect the amount of information needed during the buying.

Based on previous research, we propose to consider 3 main categories of contextual factors: Buyer type, Product type (related to buyer type), and Buying situation, as shown in Figure 5.

The classification of buyer types varies slightly from one literature to another. Here, we adopted the classification proposed by (Hutt & Speh 2012). The commercial enterprises can be further divided into 3 categories: the original equipment manufacturers (OEM), the users, and the dealers & distributors. The original equipment manufacturers purchase industrial goods to integrate them into the final products they produced. The users purchase goods in order to help produce their own products

(products purchased do not go into the final products). The dealers & distributors purchase goods for resale.

Table 2 Decisional factors from the viewpoint of the supplier

<i>Nature of the product</i>	<i>Market opportunity</i>
-Specification satisfaction (Astebro 2004)(Astebro 2003)(Udell 1989)(Cooper 1981)	-Market need (Pialot et al. 2006) (Udell 1989) (Cooper 1981)
-Product uniqueness (Daniel et al. 2007) (Udell et al. 1993) (Millier 2005) (Cooper 1981)	-Market size (Balachandra & Raelin 1984)(Carter 1982)(Hopkins 1981)(Islei et al. 1991) (Pialot et al. 2006) (Udell 1989) (Udell et al. 1993) (Millier 2005)
-Unexpected attributes for customers (Astebro 2004)(Astebro 2003) (Udell 1989) (Daniel et al. 2007)	-Trend of demand (Pialot et al. 2006) (Udell 1989) (Udell et al. 1993) (Millier 2005) (Cooper 1981)
-Possibility of patent (Astebro 2004)(Astebro 2003) (Udell 1989) (Millier 2005)	-Quality perceived (Udell et al. 1993)
-Technical uncertainty (Balachandra & Raelin 1984)(Carter 1982)(Gaynor 1990)(Hopkins 1981)(Islei et al. 1991) (Astebro 2004)(Astebro 2003) (Udell 1989) (Millier 2005)	-Competitiveness (Carter 1982)(Cooper 1981)(Yoon & Lilien 1985) (Pialot et al. 2006) (Udell 1989) (Udell et al. 1993) (Cooper 1981)
-Resource availability (Balachandra & Raelin 1984)(Carter 1982)(Islei et al. 1991)(Merrifield 1981)	-New competition (Udell et al. 1993)
-Production feasibility (Udell 1989)	-Price (Udell 1989) (Udell et al. 1993)
-Production line potential (Udell 1989)	-Profitability (Astebro 2004)(Astebro 2003) (Udell 1989) (Millier 2005) (Cooper 1981)
-Production Cost (Cooper 1981)(Gaynor 1990)(Pinto & Slevin 1987) (Udell 1989) (Daniel et al. 2007)	-Payback period (Udell 1989)
-Delivery time (Carter 1982)(Hopkins 1981)	
<i>Project/company fit</i>	<i>Societal factors</i>
-Newness to the firm (Cooper 1981)	-Legality (Udell 1989) (Millier 2005)
-Technology strategy tied to business strategy (Souder 1987)	-Safety (Udell 1989)
-Overall project/company resource compatibility (Cooper 1981)	-Societal impact (Udell 1989) (Millier 2005)
-Technical resource compatibility (Cooper 1981)	-Environmental impact (Udell 1989) (Udell et al. 1993) (Millier 2005)
-Training & experience of own people (Souder 1987) (Udell 1989) (Millier 2005) (Cooper 1981)	

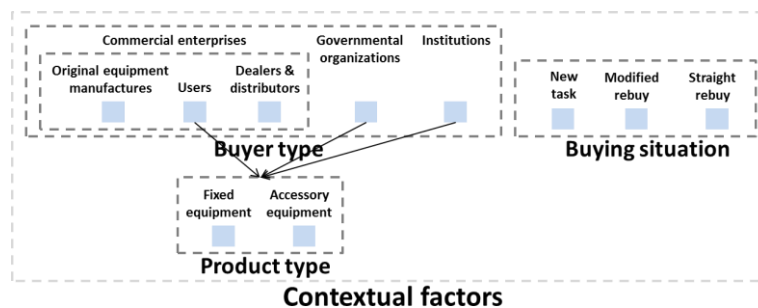


Figure 5 Contextual factors from the viewpoint of the buyer

The classification of product type and buying situation are defined almost identically across different literatures. Products can be classified into entering goods (which enters into the final product), foundation goods (which are capital items of the organization), and facilitating goods (which support organizational operations) all of which can be further subdivided. Among these product types, the products we normally see in engineering design only appear in 3 sub-categories of different product types: component parts (such as microchips, which can be installed directly into another product), fixed equipment (such as elevators in the organization), and accessory equipment (such as forklifts in the organization). According to the definition of buyer types and product types, original equipment manufacturers buy only component parts; users, governmental organizations and institutions buy either fixed equipment or accessory equipment, and dealers & distributors buy neither fixed nor accessory equipment since they purchase only things which they can resale. Therefore, we consider two types of product for the users, governmental organizations and institutions.

The buying situations have already been presented in section 3.1.

For decisional factors, we divided the factors found in previous studies into 3 categories: nature of supplier, nature of product and financial performances as shown in Table 3.

Table 3 Decisional factors from the viewpoint of buyer

<i>Nature of supplier</i>	<i>Nature of product</i>
-Reputation (Padillo & Diaby 1999) (Ho et al. 2010)	-Specification satisfaction (Padillo & Diaby 1999)(Platts et al. 2002)(Ransohoff 2004)
-Reliability (Padillo & Diaby 1999)	-Safety (Ho et al. 2010)
-Flexibility (Padillo & Diaby 1999) (Ho et al. 2010)	-Competitive advantage (Ransohoff 2004)
-Research & Development (Ho et al. 2010)	
-Technology & Equipment (Ho et al. 2010) (Platts et al. 2002)	
-Manufacturing capability (Ho et al. 2010)	
-Delivery efficiency (Padillo & Diaby 1999) (Ho et al. 2010) (Platts et al. 2002) (Humphreys et al. 2002)	
-Service (Ho et al. 2010) (Platts et al. 2002) (Humphreys et al. 2002)	
-Continuous improvement program (Platts et al. 2002)	
	<i>Financial performance</i>
	-Price/cost (Padillo & Diaby 1999) (Ford & Farmer 1986)(Probert et al. 1993)(Welch & Nayak 1992) (Ho et al. 2010) (Platts et al. 2002) (Humphreys et al. 2002)
	-Return on investment (Padillo & Diaby 1999)

4.3 Proposition of Framework

Based on factors identified from the viewpoints of buyer and supplier, we found common factors which can be regrouped from a point of view which represents the entire situation. This was done as follows: The contextual factors were regrouped into the 5 categories: supplier type, market type, buyer type, product type, and buying situation. The decisional factors were regrouped into the 3 categories: supplier related, product related, and market related.

Then, according to the information in previous works, we identify basic correlations between the contextual factors and the decisional factors, as shown in Table 4 (“1” represents a positive correlation between the two factors). In reality, companies may have different opinions about which decisional factors are correlated with which contexts. In such situations, companies can also customize the correlations according to their own opinion.

Table 4 Correlations between decisional factors and contextual factors

Decisional factors	Contextual factors	Supplier type		Market type		Buyer type					Product type		Buying situation			
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	
Supplier related	1-Flexibility*#					1										
	2-Research & Development*#				1	1										
	3-Technology & Equipment*#				1	1							1	1	1	
	4-Manufacturing capacity*#					1	1	1					1	1		
	5-Delivery efficiency*#					1	1	1					1			
	6-Service*#						1		1	1	1		1			
	7-Technology strategy tied to business strategy#		1											1		
	8-Training & experience of own people*#		1											1		
Product related	9-Functionality satisfaction*#			1		1	1	1	1	1	1		1	1		
	10-Product uniqueness*#			1				1					1			
	11-Unexpected attributes for customers*#			1				1								
	12-Possibility of patent#	1														
	13-Technological maturity*#	1			1	1								1		
	14-Manufacturability*#	1				1								1		
	15-Order lead time*#					1	1							1		
	16-Environmental impact*#								1	1	1					
17-Life-cycle cost*#			1										1			
Market related	18-Price for buyer*#					1	1	1	1	1		1	1	1	1	
	19-Market need*#			1				1					1			
	20-Market size*#			1				1	1				1			
	21-Competitiveness*#			1				1					1	1	1	
	22-Price for market*#			1				1					1			
	23-Payback period for supplier#				1											
	24-Return of investment for buyer*											1				

A-Non-corporate B-Corporate C-Existing D-New E-Original Equipment Manufacturers F-Users G-Dealers & Distributors H-Governmental organizations I-Institutions J-Fixed equipment K-Accessory equipment L-New task M-Modified rebuy N-Straight rebuy
*To be considered by buyer #To be considered by supplier

In order to focus on the most important factors, after the identification of basic correlations, the decisional factors that are not correlated with any of the contextual factors are omitted from the matrix. After filtering we end up with 24 decisional factors out of the initial 42 decisional factors. Furthermore, the decisional factors which may be interesting for the buyer and the supplier are marked by “*” and “#” respectively. We found that most of the factors in the list are interesting for both the buyer and the supplier.

The reasons for the correlations between factors are explained as follows:

Regarding to supplier type, non-corporate suppliers are more unstable, they usually have limits in development and production, and they do not have much data for early estimation. Their main concerns are usually the possibility of patent, technological and production feasibility. Corporate suppliers care more about their strategy and established competencies.

In an existing market, companies should pay particular attention to the customer needs and the competitiveness of their products, the management of cost is also important (Otto & Wood 2001). In a new market, a company should focus on the development of technology and not only listen to customer needs; the investment may be huge but in addition to high risk, there can be high reward (Otto & Wood 2001).

About buyer type, OEMs integrate the goods purchased into their own products. Therefore, they are very concerned about the specification satisfaction of the goods (Blythe & Zimmerman 2005), as well as the production capability and delivery reliability of the supplier (Hutt & Speh 2012). The supplying company needs to be involved in product design with the buyer company (Blythe & Zimmerman 2005). This also requires technical and research capability as well as flexibility of the supplier. Users purchase goods to produce their own products. They are also concerned about the specification satisfaction of the goods, and the manufacturing capacity, delivery efficiency and service of the supplier (Hutt & Speh 2012). Dealers & distributors resell the goods they purchase; they are concerned about the market, customer needs, competitors, and profit (Blythe & Zimmerman 2005). Governmental organizations usually offer the contract to the lowest bidder (Blythe & Zimmerman 2005); they sometimes order specific products which are not available to the general public and they may care more about the environmental impact than other buyers. Institutions’ budgets are almost always very tight (Blythe & Zimmerman 2005). Their concerns are similar to governmental organizations (Hutt & Speh 2012).

Regarding product type, the fixed equipment affects the buyer’s scale of operations (Hutt & Speh 2012), so specification satisfaction, service and return on investment are the most important factors (Hutt & Speh 2012). The accessory equipment is usually short-lived (Hutt & Speh 2012), so cost is the main concern here.

About buying situation, a lot of information is needed in a new task, since decision makers lack strong tendencies toward a particular supplier or an architecture (Hutt & Speh 2012). In a modified rebuy, the specification and the quantities ordered may be changed, and the buyer is also concerned with the new technology or better offers compared to the current supplier (Blythe & Zimmerman 2005). In a straight rebuy, the supplier should also demonstrate to the buyer their competitiveness in technology or price compared to other suppliers (Blythe & Zimmerman 2005).

For a particular negotiation, contextual factors can be selected from the list. Then decisional factors which are correlated with at least one of the selected contextual factors are identified as the main factors for this negotiation.

An example is presented in Figure 6. In the example, the correlations are as represented in Table 4, the supplier is a *corporate* organization, the buyer is a *governmental organization*, the product is *fixed equipment* in an *existing* market, and the buying situation is *modified rebuy*. By using the framework, 16 main factors were identified. Therefore companies can focus on the estimation and negotiation of these factors before signing the contract. The identification of these factors helps the company to have a global view of the project and thus reduce risk. It also helps companies to identify estimation targets which allows saving time and effort. By varying the contextual factors selected, different main factors can be generated. The comparison of results between different contexts is not presented in this paper due to the page limit.

5 CONCLUSION

The aim of this work is to propose a decision support framework for companies in early negotiations, so that a particular company in a particular negotiation situation can identify the most important

factors to be considered before signing the contract. In addition, this work can also be used by researchers who want to develop supporting tools for early negotiation.

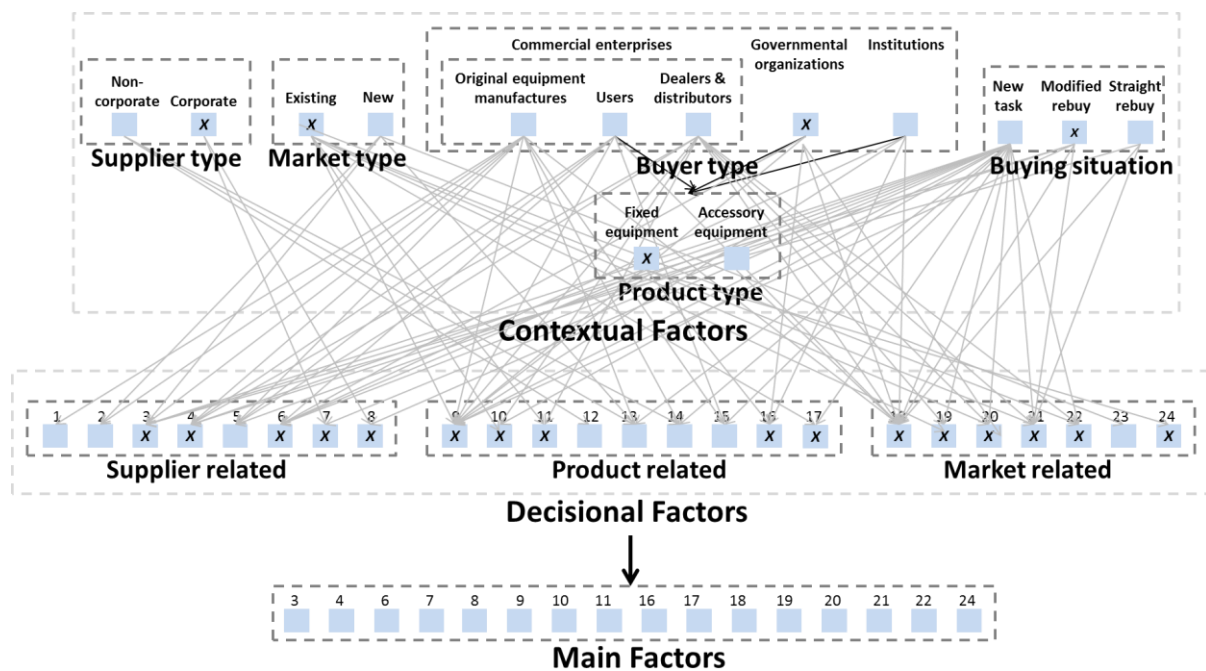


Figure 6 Example for main factor identification by using the proposed framework

Based on extensive literature review, we propose for the early negotiation stage both the contextual factors as well as decisional factors, and the basic correlation between decisional factors and contextual factors. The correlation can also be customized according to the opinion of the company. We then construct the framework which identifies main factors according to the context of negotiation. The framework is illustrated with an example.

One limitation of the framework might be the confidentiality problem for obtaining some of the factors. For instance, it might be delicate for suppliers to share their technology and equipment information with the potential buyer in the early negotiation stage.

The framework proposes important factors to be considered during early negotiation. However, some of the factors are hard to estimate during this stage because of the lack of information and manpower. In our ongoing research, a framework aiming at estimating these factors in early negotiation will be proposed.

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