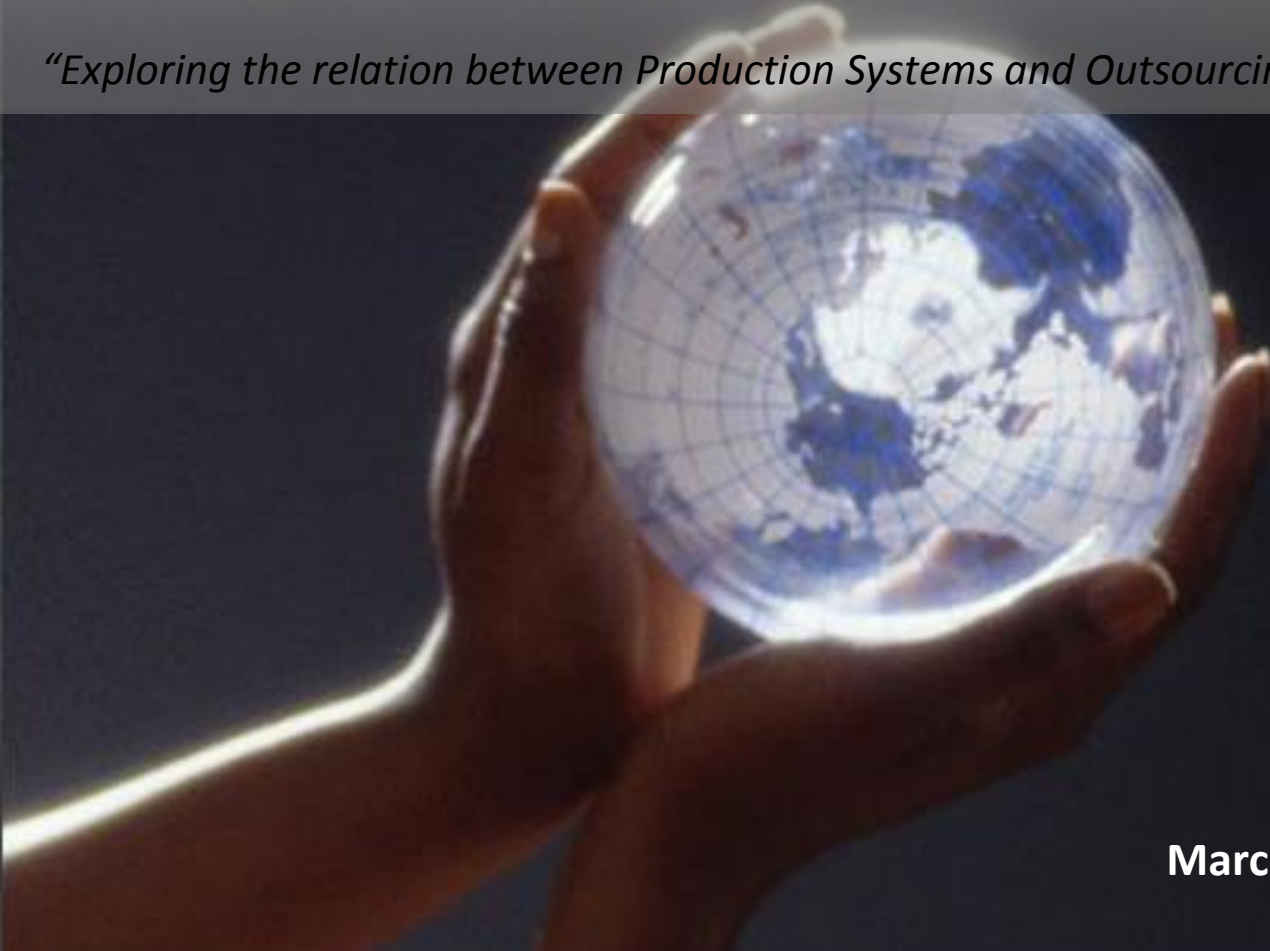


# Master Thesis

## Outsourcing of Production Systems

*“Exploring the relation between Production Systems and Outsourcing Strategies”*



March 31, 2009

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## Preface

In September 2007, I started the Master Business Administration at the University of Twente. Now about eighteen months later, I will finally complete the Master with this thesis. This is a wonderful feeling, because from now on, I will be able to start applying my knowledge and to make a valuable contribution to the 'real' world.

I have performed this research at Jansen Venneboer Inc. in Wijhe. Jansen Venneboer provided me with the opportunity to write a complete business plan for the small water management products. Although I really enjoyed this assignment, it needed to be adapted to the required theoretical depth of the University of Twente. After several consultations with Jansen Venneboer and with my supervisor, we came to the research as it is presented here. I want to thank Jansen Venneboer, in particular Mr. Lucien Perizonius for his patience and permission to let me fulfill the assignment as it was required by the University.

Secondly, I want to thank my first supervisor Huub Ruël for his support during the journey of carrying out this research and writing my thesis. When I lost the 'red line' of my research, I could meet with Huub and discuss things, which brought me back on track. Although Huub went to Lebanon to give lectures, he still took the time to read the thesis and have contact with me by Skype and email. I also want to thank my second supervisor Sirp de Boer. During the last phase of my thesis, Sirp helped with some necessary improvements. Furthermore, I want to thank my neighbor Mieke Steures for her grammatical advice on this thesis.

I want to thank my colleagues at Jansen Venneboer for their interest in my assignment and for the pleasant ambiance in which they work there. Furthermore, I want to thank everyone who helped with the thesis by discussing it. In particular, I want to thank the project managers of Jansen Venneboer: the office where I spent most of my time. Not because they expect those thanks, but because it was really a great stay. It was sometimes nice to talk about something else than the thesis, it cleared my mind. Besides, unintentionally I picked up a lot of information about the ins and outs of project management.

My research included a survey study, which I carried out in cooperation with FME-CWM. I want to thank FME-CWM for their collaboration and the resources they put at my disposal to execute the survey. Although for privacy reasons, no names are mentioned in this research, I want to thank all the organizations which have cooperated with me.

This was a long list of thanks, but it is not complete yet. I want to thank my parents, family and friends for the solid basis, from which I could start my education and fulfill my Master thesis. Then, last but not least, I want to thank Ellen for her support to let me fulfill the Master. It took a lot of her patience, which I am very grateful for.

I hope you enjoy reading this thesis, and that you learn more about the relation between production systems and outsourcing strategies!

Roy Dashorst  
Wilp-Achterhoek, March 2009

## Management summary

Outsourcing of production is an emerging trend, due to the tight labor market, and the new Lisbon strategy. Although a lot of research is performed on outsourcing decision factors, a clear framework which enveloped the entire production system is lacking. The purpose of this research is to address this gap, and to explore the relation between production systems and outsourcing strategies. Due to the high variety of production systems and outsourcing strategies, an abstract level of research has been chosen. This has resulted in the following central question:

*“What is the relationship between outsourcing strategies and production systems?”*

Four outsourcing strategies can be distinguished: (1) in-house, (2) captive off-shoring, (3) outsourcing, (4) off-shore outsourcing (Volberda, Van den Bosch, Jansen, Szczygielska, & Roza, 2007). These strategies differ in the extent of **ownership** and **control**. Furthermore, they differ in the actual **location** of production.

The production systems are regarded as the independent variables, and are divided into: (1) organizational characteristics, (2) managerial characteristics, (3) physical characteristics.

A quantitative research approach is used for this research, which consisted of two parts. The first part consisted of a survey research, and has been accomplished in cooperation with FME-CWM. The surveys are randomly sent to profit making production organizations, which were members of FME-CWM. In total, 1164 organizations have been invited to contribute to this research. With 22 responses, a low response rate was obtained. For this reason, organizations on the InfraTech fair 2009 were approached to cooperate. Through a combination of face-to-face interviews and the survey, 4 new respondents were acquired. From the 26 respondents in total, 18 were useful for this research.

The independent production system characteristics are compared with the dependent outsourcing strategy characteristics (ownership, control and location). The findings of the research resulted not in just one relation. Considering the main findings of this research, the following is suggested:

- It is recommended for organizations that expect a communication barrier or a culture barrier to produce nationally
- It is recommended for organizations that focus on quality, CSR, process innovation, product innovation and employee policy to keep the production in ownership.
- It is recommended for organizations that have: larger production sizes, highly automated production processes, and highly complex production processes to keep the production in ownership of the organization.
- It is recommended for organizations that do not focus on cost reductions, process innovation to produce internationally

This research had several limitations. First of all, due to the high level of abstraction, it is possible that the proposed relations of this research, are not applicable for all production organizations. Furthermore, the low response rate of this research could result in misleading findings.

Also the use of questionnaires could result in misleading findings. It is not sure whether the right person filled in the questionnaire.

The last limitation of this research are the chosen production system characteristics. Although the production system characteristics were accurately operationalized, it is possible that different respondents had different thoughts, when considering the production system characteristics.

The relations suggested in this research could be used as a guide during the outsourcing decision process. When an organization considers its production system on the variables proposed in this research, it is possible to create a broad view of the most appropriate outsourcing strategy.

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## 1 Research introduction

This chapter describes the research design. It starts with the motive and background of the research. The background leads to the goal and the central question. The central question is divided into 4 sub questions.

### 1.1 Motive

This research has been written on behalf of Jansen Venneboer Inc. in Wijhe. For almost a hundred years Jansen Venneboer has been participating in civil engineering. The work field can be divided into four main domains: water management, traffic regulation, water pumps for developing countries, and service & maintenance. The assignment consisted of writing a business plan for small-water-management products. This research is based on a part of the business plan, which consisted of finding the best suitable outsourcing strategy for small-water-management products.

### 1.2 Background

In the past, outsourced activities mostly contained non-core processes. The new trend in globalization consists of outsourcing core processes. There are different reasons for this new trend and for the increasing popularity of globalization. The main reason for outsourcing (non)-core processes are the low costs of labor in Low Cost Countries (LCC). Furthermore, motivators for outsourcing are: better quality, lower prices of raw materials, and being near the growth market.

A second reason, which holds good for Dutch organizations, is the expected development of the economically active population (both sexes), which as a percentage of the total population shows a decreasing trend. However, according to the SEO Economic Research (Biermans & Leeuwen, 2006), the demand for labor is expected to increase. Compared with the decreasing economically active population, this could result in a tight labor market.

A third reason is due to the European Commission, which introduced the Lisbon strategy. The goal of the Lisbon strategy is to turn the European Union into the most competitive knowledge economy in the world. According to the Commission, there is a strong economy when:

- There is a lot of competition
- The economy can adapt itself to the developments in the world
- People and organizations possess knowledge which leads to new discoveries
- Free exchange of knowledge
- Stimulating small and medium-size enterprises

An increasing competition could lead to a pressure on product prices. As a result, cheap producing could be a must and apart from outsourcing non-core processes, outsourcing core processes to LCC may be interesting.

The decision of outsourcing, also known as the make-or-buy decision, can be defined as a highly complex and emotive one that has an impact on profitability, investment decisions, working capital, borrowing and competitive position. A wrong decision can lead to higher product costs, misuse of resources and a loss of opportunities, customers and market shares (Tayles & Drury, 2001).

To prevent a wrong outsourcing decision, a number of authors have written about decision factors and proposed frameworks for considering the outsourcing decisions (Cox, 1997; McIvor, Humphreys, & McAleer, 1997; Tayles & Drury, 2001; Venkatesan, 1992; Welch & Nayak, 1992).

These authors based their framework on four perspectives (Cánez, Platts, & Probert, 2000). According to Cánez et al. (2000) the concept of **transaction cost** plays an important role in many outsourcing models. The transaction cost theory can be traced back to Coase (1937) and to Commons (1970). Williamson (1975) has been responsible for the revival of this concept and for its introduction into organizational theory (Cánez et al., 2000).

McIvor et al. (1997) and Venkatesan (1992) address make-or-buy from an additional **resource based view**, by focusing primarily on existing internal resources. Venkatesan (1992) suggests the identification of strategic sub-assemblies and manufacturing technologies, whereas McIvor et al. (1997) in a more generic way, refer to core activities, and emphasize the strategic attention of the make or buy decision. Cox (1997) expands the idea of critical internal resources to the identification of critical assets within the entire supply chain.

Tayles & Drury (2001) approached the make-or-buy decision by considering **strategy issues**, detailed financial evaluation, efficiency and risk dimensions relating to supplier quality, lead times and delivery reliability.

Welch & Nayak (1992) and Probert (1997) approached the make-or-buy decision by considering the process **technology**. The positioning of the technologies seems useful in identifying clear make-and-buy decisions. However, there seem to be some gray areas which need further investigation (Cánez et al., 2000).

The above mentioned studies are based on the following approaches:

- Transaction costs, *focus on reducing transaction costs*
- Resources, *focus on resources*
- Strategy, *focus on strategy issues*
- Technology, *focus on process technology*

The four approaches are related with the production system. However, an overall research which considers the whole production system is lacking. This research aims at addressing this gap by exploring the relation between production systems and outsourcing strategies. The goal is to present a general framework which organizations could use when considering outsourcing. It will increase the understanding of production systems and outsourcing strategies. Furthermore, by exploring this relation it will increase understanding of how these two elements are related.

### 1.3 Research Goal

For a clear description of the research goal, a reference will be made to a totally different research, executed by the Russian engineer Genrich Altshuller. Altshuller presented TRIZ, a Russian acronym for “Teoriya Resheniya Izobreatatelskikh Zadatch”, which in English means “Theory of Inventive Problem Solving”. Altshuller began in 1946 with the development of the theory during his work at the patent office of the Russian navy. Altshuller believed that all inventions could be reduced to a number of systematic patterns, and that the evolution of technological progress, expires according to a number of predictable patterns. The model used by Altshuller is presented in Figure 1.

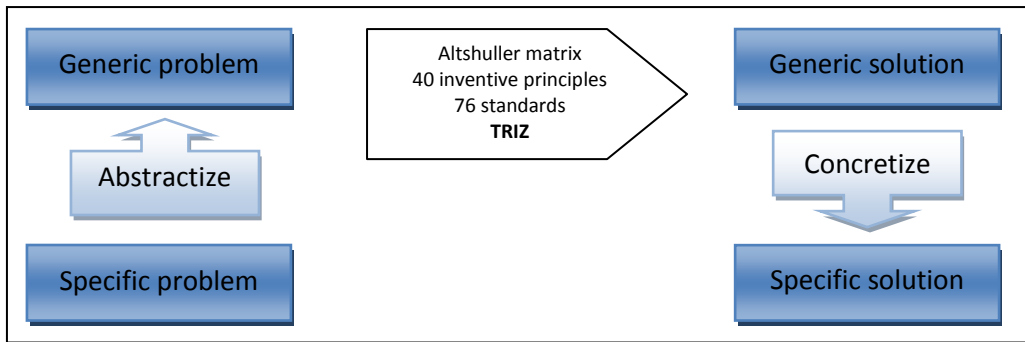


Figure 1: TRIZ (1998)

The main reason for the reference to TRIZ, is the increase in the level of abstraction. An abstract level is characterized as a simplified version of a problem of which the details have been omitted. Altshuller lifted specific problems to a higher abstraction level by formulating general problems.

Coming back to this research, the two main subjects are **production systems** and **outsourcing strategies**. This research explores the relation between production systems and outsourcing strategies, from an organizational point of view. What kind of production system do we have and which outsourcing strategy suits best. For this purpose, the relation between generic production systems and generic outsourcing strategies has been explored.

The reason for the high level of abstraction is that production systems and outsourcing strategies consist of a large number of specific characteristics. The goal of this research is to establish generic relations, which are valid for all production organizations. Due to the broad target group, and the comprehensive subjects (production systems and outsourcing strategies) a high level of abstraction is preferred.

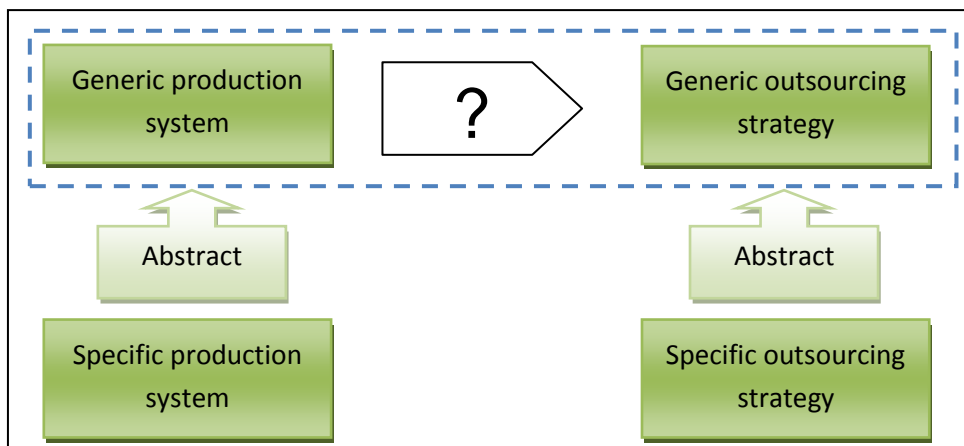


Figure 2: Research goal

## 1.4 Central question

What is the relationship between outsourcing strategies and production systems?

Definition	Explanation
Outsourcing strategy	Subcontracting custom-made articles and constructions, such as components, subassemblies, final products, adaptations and/or services to another company (Cánez et al., 2000; Hiemstra & Tilburg van, 1991)
Production system	A set of interrelated elements that are designed to act in a manner that generates final products whose commercial value exceeds the costs of generating them (MacCarthy & Fernandes, 2000)

Table 1: Central question definitions

## 1.5 Research questions

To find an answer to the central question, research questions have been formulated. As described in the background, several studies approach the outsourcing decision from different positions. Firstly, the main elements of this research are studied to provide a clear view on these elements. After studying the main elements, it will be studied how the main elements are related. Finally, the question of which production system characteristics have the largest influence on outsourcing strategies will be examined. This ensures that a complete overview of the relation will be presented.

1. What are the characteristics of production systems?
2. What are the characteristics of outsourcing strategies?
3. How are characteristics of production systems and outsourcing strategies related?
4. Which production system characteristics have the largest influence on outsourcing strategies?

## 2 Theoretical framework

The purpose of this chapter is to outline the theoretical foundation of this research. The first section starts with the development of the theoretical framework. The upcoming sections consist of the elaboration of the theoretical framework.

### 2.1 Framework development

This section starts with discussing the main elements of this research, which are:

- Outsourcing strategies
- Production systems

Finally, the theoretical framework has been constructed, based on the literature reviews of the two main elements. See Figure 3.

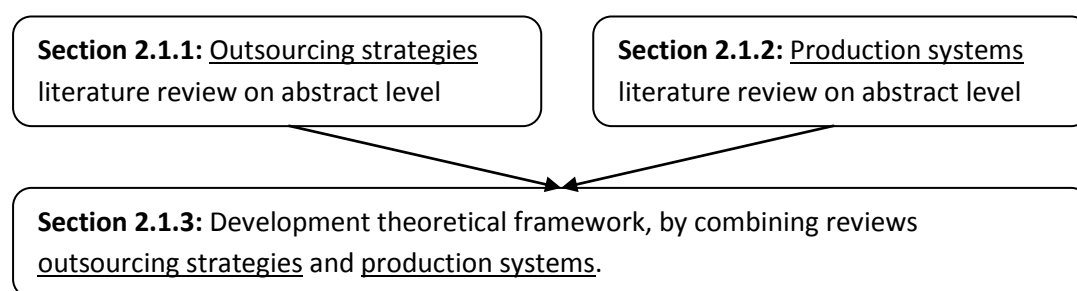


Figure 3: Framework development

#### 2.1.1 Outsourcing strategies literature review

Outsourcing is contracting production of components, subassemblies, finished products, processes and services to another company, but on the specifications of the contracting company (Hiemstra & Tilburg van, 1991). International outsourcing is also known as global sourcing. Trent & Monczka (2003) studied the definition of global sourcing, and defined it as the worldwide integration of engineering, operations, logistics, procurement, and even marketing within the upstream part of a firm's supply chain.

Volberda et al., (2007) proposed 4 outsourcing strategies. The outsourcing strategies are presented in Figure 4.

##### In-house

In-house, or onshore production is like the word suggests, production in the organization. There are no third parties involved, and it is therefore different from the other strategies. With in-house production, the organization has complete control over the production system. In-house production consists of a national located production process.

##### Captive off-shoring/ subsidiary

In this outsourcing strategy, the organization moves the production activity abroad but keeps the ownership. Compared with in-house production, captive off-shoring is located abroad. For example, this could be achieved by opening its own research and development department abroad. Although the organization keeps the ownership, local employees will be contracted which could lead to new knowledge.

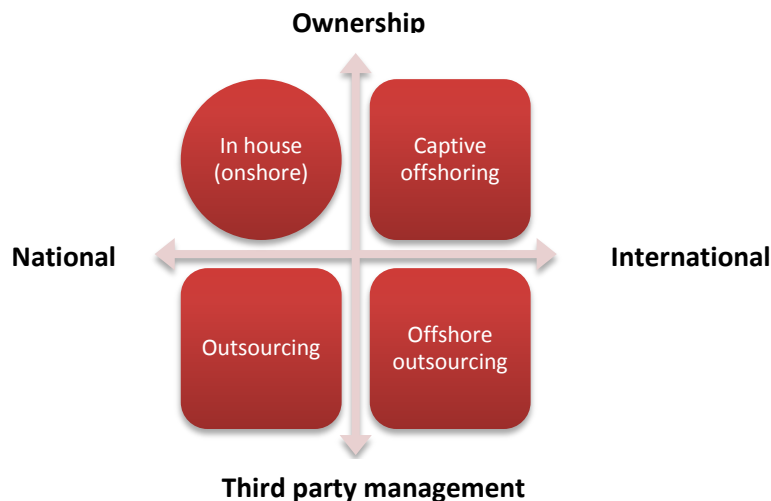


Figure 4: Off-shoring versus outsourcing, source: Volberda et.al (2007)

### Outsourcing

Outsourcing activities consist of outsourcing in the same country where the organization is located (nationally). In this case, the organization places the production elsewhere, but still keeps it at close range. This provides the organization with a higher flexibility. A third party has the ownership of the production.

### Offshore outsourcing

Offshore outsourcing consists of outsourcing activities abroad, while a third party takes care of the outsourced activities. This third party could be both a national as well as an international party. The main organization is minimally involved in the production process.

The strategies presented by Volberda et al. (2007) are based on two variables, concerning **management** and **location**. Apart from the management and location of outsourcing, the outsourcing strategy also involves the level of **control**. Many authors have written about control systems within organizations (Langfield-Smith & Smith, 2003). Langfield-Smith & Smith (2003) presented a Management Control System (MCS), which goes beyond the borders of organizations and represents control systems between organizations. Dunning (2000) presents the OLI paradigm (Ownership, Location and Internalization). Ownership and location match with the management and location variables presented by Volberda et.al (2007). Internalization is about imperfections in intermediate product markets (Dunning, 1993). Intermediate products flow between activities within the production sector. Market imperfections generate transaction costs and these costs are often minimized for the sector as a whole by bringing interdependent activities under common ownership and control.

Based on the model of Volberda et al. (2007) and the paradigm of Dunning (2000), the following outsourcing variables are used:

### Outsourcing variables

- Management (ownership)
- Location
- Control (internalization)

## 2.1.2 Production systems literature review

Many authors have written about the classification of production systems. According to MacCarthy & Fernandes (2000), a production system can be divided into two types of subsystems: **physical systems** and **managerial systems**. This division is also emphasized by Liker, Fruin & Adler (1999). They differentiate between the **hard-side** of the production system (hardware) like equipment, technical process flow, automation, flexible assembly, and the **soft-side** of the production system (software) like control systems.

Groover (2000) defined production systems as a collection of people, equipment, and procedures organized to perform the manufacturing operations of a company. Equipment and procedures are described in the physical and managerial systems characteristics. However, as Groover suggests, people are also involved in production systems. For this reason, apart from the physical and managerial characteristics of the production system, **organizational characteristics** are also regarded as production system characteristics.

### Production system variables

- Organizational characteristics
- Managerial, soft side characteristics
- Physical, hard side characteristics

## 2.1.3 Framework construction

In the previous sections, production system characteristics and outsourcing strategy characteristics were discussed. As will probably become clear, a lot of literature could be found about production systems and outsourcing strategies. This research emphasizes the abstract level of the relation. The goal of this research is to explore the relation between generic production system characteristics and generic outsourcing strategy characteristics, indicated with the dotted line in Figure 5. Figure 5 presents the theoretical framework, which forms the basis of this research.

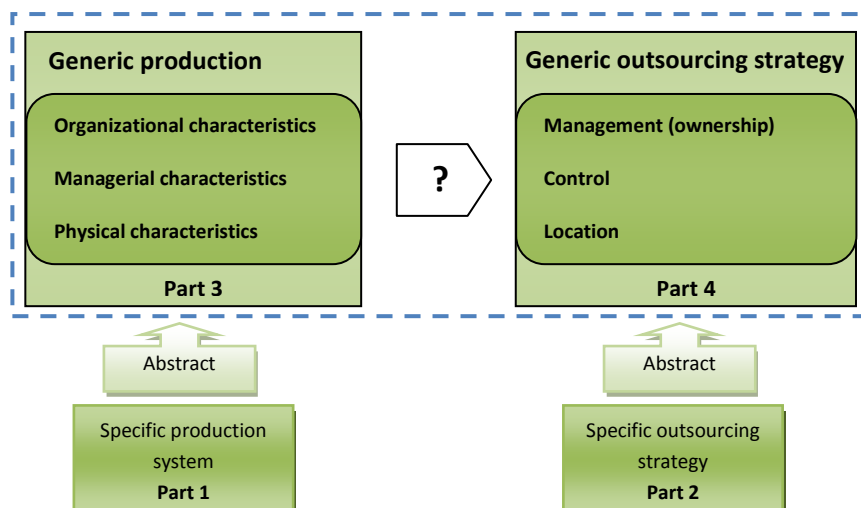


Figure 5: Theoretical framework



Considering the theoretical framework (Figure 5), the relation will be explored from the generic production system to the generic outsourcing strategies (referring to the arrow with the question mark). The outsourcing strategies are regarded as the dependent variables, whereas the production system characteristics are regarded as the independent variables.

To present a clear building up of chapters, first a theoretical elaboration of the dependent generic outsourcing strategy characteristics will be presented. Secondly, the generic production system is presented, with additionally the propositions. The propositions consist of the expected relation and/or expected influence of the generic production system characteristics on the generic outsourcing strategy characteristics (again referring to the arrow with the question mark Figure 5).

## 2.2 Framework elaboration: generic outsourcing strategy

This section outlines the characteristics of outsourcing strategies on an abstract level. Figure 6 presents the elaborated generic outsourcing strategy variables, portrayed in the theoretical framework.

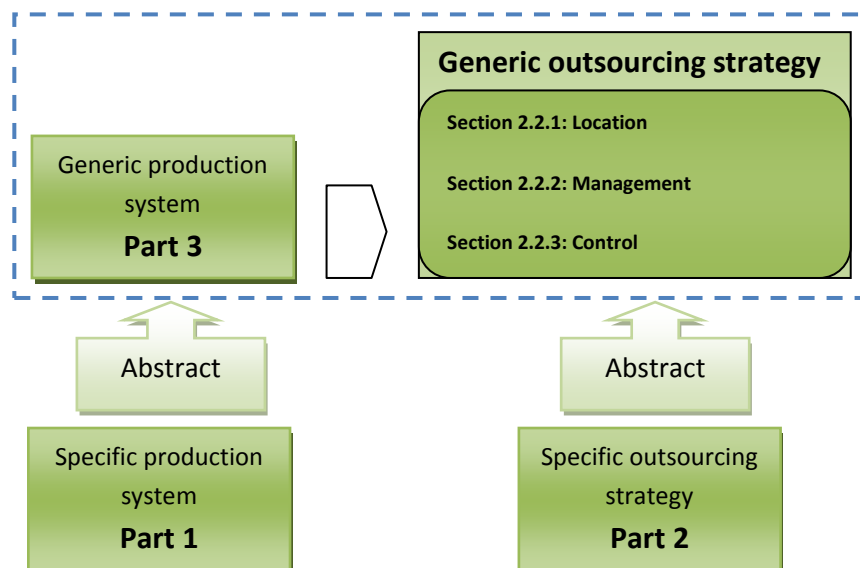


Figure 6: Generic outsourcing strategy elaborated

The generic outsourcing strategy characteristics are described by the three main variables of section 2.1.1.:

- **Location**
- **Management**
- **Control**

### 2.2.1 Location

A number of authors have written about the specific location decision process (Graf & Mudambi, 2005). The decision process of a location on a specific outsourcing strategy level consists of the variables infrastructure, country risk and government policy (Dunning, 1988). On an abstract level, the location is defined as the geographical location.

The geographical location is split up into national and international for the following reason: on an abstract level, organizations that are outsourcing make the choice for outsourcing to a location, where they are familiar with the infrastructure, country risk and government policy (national), or for outsourcing to a location where they are not familiar with the infrastructure, country risk and government policy (international).

### 2.2.2 Management

The management of the production is the second characteristic for clarifying outsourcing strategies. C  nez et al. (2000) defined the management of the production process as ‘ownership of the process’. A first clear distinction could be made between outsourcing in ownership and outsourcing to third parties. An example of outsourcing, but still keeping the production in ownership, is by starting a new department in, for example, China. By starting a new department, the organization has the production in ownership. On the contrary, an organization could also choose to outsource the production to third parties. In that case, the ownership of the production moves to the other organization. The organization that outsources its production is partly dependent on the other organization.

### 2.2.3 Control

In addition to the level of ownership of the production, the level of control is also specified. In his article with the title ‘the seven deadly sins of outsourcing’, Barthelemy (2000) called losing control as a deadly sin. The level of control is partly dependent on the cooperation of the organizations, often defined in contracts. An organization could have outsourced the production, but still keep the control of the production. An example will clarify the difference between the level of control over production and the level of ownership.

*An organization could outsource its production to third parties, and with that, outsourcing the ownership of the production. However, the organization can get control over the production through clear contracts. Furthermore, the organization could also receive control about the way that the products are produced by considering for example the ISO qualification of the organization where the production is outsourced to.*

## 2.3 Framework elaboration: generic production system

The upcoming sections describe the elaboration of part 3, the generic production system of the theoretical framework (Figure 5). An overview of the variables is presented before discussing them, to increase the readability of the section. An overview of the elaborated generic production system is presented in Figure 7. The reasoning of the variables is presented further below.

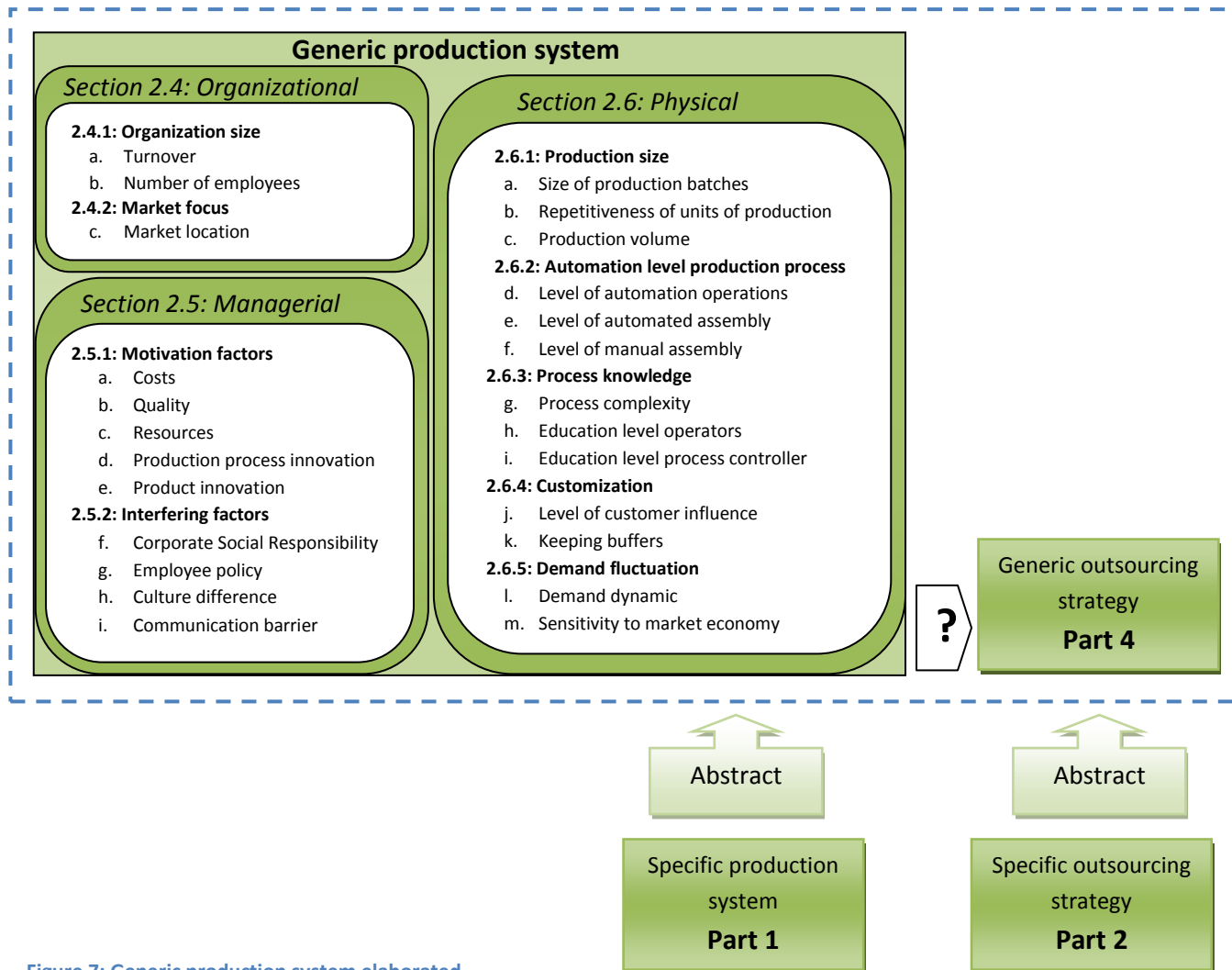


Figure 7: Generic production system elaborated

### Propositions

As mentioned in the beginning of chapter 2, after describing the generic production systems, propositions will be formulated for exploring the relation between generic production systems and generic outsourcing strategies.

The generic production system characteristics are taken as given and it is presumed that they influence the outsourcing strategy variables. For this reason, the production system characteristics are taken as independent variables, and the outsourcing strategy variables are taken as dependent variables.

#### Independent: generic production system characteristics

1. Organizational characteristics
2. Managerial, soft side characteristics
3. Physical, hard side characteristics

#### Dependent: generic outsourcing strategy characteristics

1. Management (ownership)
2. Control
3. Location

## 2.4 Organizational characteristics

Regarding the organizational characteristics, those characteristics are meant which could influence the outsourcing variables. A first organizational characteristic is suggested by Jackson, Schuler & Rivero (1989). As organizations grow from small to large, a number of other changes typically occur. For example, jobs in large organizations are generally more specialized than those in small organizations, as specialization is one means through which large organizations attempt to increase efficiency (Baron, Dobbin, & Jennings, 1986; Blau, 1972; Weber, 1947 in Jackson et al., 1989). More specialized jobs mean that employees in larger organizations should require less diverse skills, and consequently, they may need less training overall. Therefore, the influence of the **organizational size** will be taken into account.

**Market location** is regarded as the second organizational characteristic. An organization delivers to an international market, a national market or both markets. Although no empirical evidence could be found, it is suggested that from the producing-near-the-market perspective, the market location could influence the outsourcing decision. Therefore, the market location has been considered as organizational characteristic.

### 2.4.1 Organizational size

Several authors present different methods for measuring organizational size (Damanpour, 1992). Kimberly (1976) conducted a literature research of the variables to measure organizational size. More than 80% of the 80 articles which were reviewed, used **number of employees** as variable to measure organizational size. She argues that different aspects of size are primarily relevant to different kinds of organizational structure. Therefore, different measures of size would be appropriate for different types of organizations. A personnel measure is preferred for labor intensive organizations (Kimberly, 1976).

Another characteristic for describing the organizational size are the financial resources (Kimberly, 1976). The different outsourcing strategies involve different economic investments. An item for measuring the financial resources is **turnover**. An organization with a high turnover could invest in a new department abroad more easily, in contrast to an organization with a lower turnover.

#### Proposition

This research focuses on labor intensive production organizations, therefore a personnel measure is preferred. A large number of employees indicates a high number of human resources. An organization with a large number of employees needs to keep work for its employees. Therefore, it is assumed that organizations with a large number of employees, will probably produce in ownership. Because the employees are contracted by the organization, a high level of control over the production process is expected.

Organizations with a large turnover are better able to start a new department location elsewhere. In this way, organizations with a large turnover keep the ownership of the production process, and therefore also have control over the production. Large organizations are more often supplying to international markets. Considering the producing-near-the-market perspective, it is expected that large organizations have production locations nationally and internationally, and have more international locations than smaller organizations.

Due to the reasons above mentioned, it is assumed that organizations with a large turnover and a large number of employees produce more often in ownership, keep more control over the production, and produce more often internationally.

*1 Compared with organizations with a smaller turnover and a lower number of employees, organizations with a larger turnover and a larger number of employees*

*a: produce more often in **ownership***

*b: **keep more control** over the production*

*c: produce more **internationally***

## 2.4.2 Market location

To strengthen the assumption in section 2.4.1 that organizations are producing-near-to-the-market, the influence of **market focus** on the location of production will be examined. There are some reasons because of which producing near the customer is recommendable:

- Lower logistic costs
- Shorter communication lines with the customers

The location of the market could have an influence on the location where the products are produced. Organizations that produce nationally, but sell on an international market will have higher transportation costs than organizations that only sell on a national market.

### Proposition

It is assumed that the market focus will not directly influence the variables considering management and control, but only the location variable. Considering the near-to-market aspect, it is expected that the market focus of organizations is equal with the location of production.

*2. The market focus of organizations is **equal** with the **location** of production*

## 2.5 Managerial, soft side of production systems

According to Madhok (2002), strategic management is not only about coordination and resource allocation inside the organization, but also about outside organizational boundaries. This indicates an influence of strategic characteristics on the outsourcing strategy. Kotabe & Murray (2004) elaborate upon this point and suggest that outsourcing has become an increasingly critical strategic decision that is influenced by the capabilities which are needed to compete. These authors suggest that the strategy of an organization influences the outsourcing strategy. The strategy factors of an organization are regarded as the managerial, soft side of production systems. The strategy and policy of an organization to reach competitive advantages, influences the product strategy which concerns the used outsourcing strategy.

Organizations differ in the extent of focus on strategically important factors. One organization could focus on decreasing costs, whereas another organization focuses on delivering high quality. It is proposed that this difference in focus influences the outsourcing strategy decision.

Some strategic factors will encourage an organization to outsource production, whereas other strategic factors will discourage an organization from outsourcing production. Therefore, a difference is made between:

- **Motivation factors**
- **Interfering factors**

Motivation factors are regarded as reasons for deciding to outsource, interfering factors are regarded as reasons for not deciding to outsource.

### 2.5.1 Motivation factors

A first motivator for outsourcing are **cost reductions** (Domberger, 1998; Embleton & Wright, 1998; Fill & Visser, 2000; Kimberly, 1976; King & Malhotra, 2000; Maskell, Pedersen, Petersen, & Dick-Nielsen, 2007; Porter, 1980 in Van de Ven, 1996; Volberda et al., 2007). Fill & Visser (2000) proposed that outsourcing is a possible solution to control increasing costs and is compatible with a cost leadership strategy. Outsourcing could lead to cost reductions. Two strategies are discussed:

Focusing on transaction costs (Domberger, 1998):

- Organizations which the production is outsourced to, can reach cost advantages due to economies of scale (Vining & Globerman, 1999). Economies of scale may be utilized by any organization expanding its scale of operation
- Organizations can experience diseconomies of scope in management of multiple organizational activities. In this case focusing on core competences and outsourcing other activities could lead to cost reductions

Focusing on low cost countries (LCC) (Pyke, 2007):

- LCC have a lower cost of raw material and components
- The manufacturing costs of LCC's are lower, with regard to labor, assembly and equipment costs
- Taxes in LCC's are most often lower than in other countries

One remark should be made. According to Humphreys, Lo & McIvor (2000) basing the outsourcing decision on cost reductions is the classical way of looking at the make or buy decision. The reason for this is that many organizations have inadequate costing systems. An example is that labor hours are still widely used as the basis for allocating overhead, even when the production process is highly automated (Humphreys et al., 2000).

A second motivator is **quality**. Inman, Blumenfeld, Huang & Li (2003) presented a research about designing production systems for quality in an automotive perspective. They proposed that US car manufactures enthusiastically embraced outsourcing for improving the quality. The rationale for the popular strategy of outsourcing is to allow the outsourcer to focus on its core competence (Inman et al., 2003).

Another reason for the improvement of quality through outsourcing is contracts between the main organization and the outsourced organization (Lankford & Parsa, 1999). Sweet (1994 in Lankford & Parsa, 1999) proposed that many organizations admit that they have little control over their in-house support departments, and see a legally enforceable contract with an external supplier as a way of keeping the lid on costs and improving the quality of the service they get. In this way, a contract functions as a guarantee for a high quality.

A third motivator is increasing innovation possibilities. This motivator is two sided, and is divided into **production process innovation** and **product innovation**. Porter (page 22, Porter, 1983) describes the difference between production process innovation and product innovation:

*“Product innovation is the dominant mode of innovation and aims primarily at improving product performance. Successive product innovations ultimately yield a “dominant design” where the optimal product configuration is reached. Process innovation is initially minor in significance, and early production processes are characterized by small scale, flexibility, and high labor skill levels. As product design stabilizes, increasingly automated production methods are employed and process innovation to lower costs takes over as the dominant innovation mode. Ultimately, innovation of both types begins to slow down.”*

The pattern described by Porter is illustrated in Figure 8.

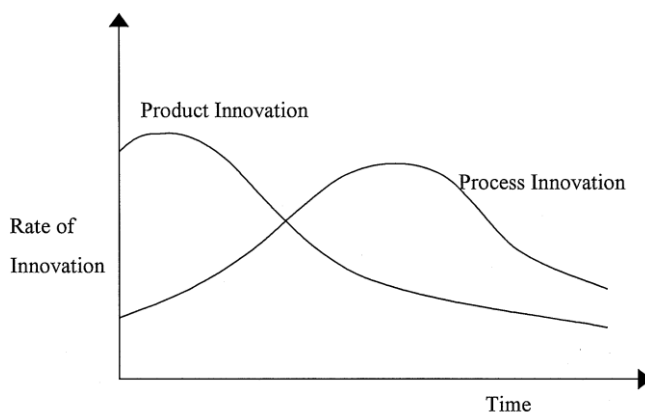


Figure 8: Dynamics of product and process innovation (Source: Mann, 2001)

A combination of new knowledge and technology is one of the main variables which lead to increasing innovation possibilities (Maskell et al., 2007). Like other authors, Mason and Wagner (1994) have stressed the importance of high grade human resources for innovation. These human resources could be accomplished through outsourcing. Furthermore, firms operating in urban and non-urban areas might make differential use of external resources as part of their innovation activity (Love & Roper, 2001). According to a research of Maskell et al. (2007), organizations which emphasize the innovation motive reached a reduced development time of new products and shortened their delivery time.

A fourth motivator is the availability of **resources**. Resources include labor, capital, plant, and equipment time (Tayles & Drury, 2001). A lack of resources could result in the decision to outsource production, however in this case this results in a low bargaining power in negotiating future contracts (Tayles & Drury, 2001). The reason for this is that the organization is dependent on the organization where the production is outsourced to, because they do not have the resources to produce the product in-house.

### Proposition

Motivation factors are partly based on cooperation with external organizations, which could for example lead to innovation possibilities, cost reductions and improving quality. Therefore it is assumed that organizations with a high focus on the motivation factors, more often outsource their production, but still keep control over the production. As for the influence on the dependent location variable, it is expected that cost reductions as the motivation factor for international locations, like LCC, are preferable. Regarding the variables improving quality, resource location, process innovation and product innovation no clear preference for a location is assumed.

3. *Compared with organizations that do not focus on motivation factors, organizations with a higher focus on motivation factors*

a: **outsource** production more often

b: **keep control over** the production

4. *Compared with organizations that do not focus on cost reductions, organizations with a higher focus on cost reductions outsource more often to **international locations***

## 2.5.2 Interfering factors

Apart from motivators, there are interfering strategic factors which influence the outsourcing strategy. According to Stainer & Grey (2007), organizations need to consider **Corporate Social Responsibility (CSR)** when considering outsourcing. Outsourcing to low-wage countries is associated with differences in government policies. The extent of emphasizing on CSR could influence the outsourcing strategy. An example is presented:

*When organization A is a well-known organization and has influence at Global Governance level, CSR plays an important role. In this case, it will damage the position of organization A when it turns out that they outsource production to low wage countries where for example, child labor takes place. The same counts when an organization outsources its production to an organization that pollutes the environment. To prevent such scandals, organization A would probably choose for an outsourcing strategy where they could still monitor the production process.*

A second interfering factor is the **employee policy**. According to Levy (2005), the current wave of international outsourcing signals a new structural development in the global political economy, one that raises concerns not just for the competitiveness of countries but for the welfare of large groups of workers. The employee policy of an organization influences this welfare. To emphasize the influence of the employee policy, a practical example is given.



*Flextronics International Europe in Venray started outsourcing production of copiers to Ukraine and Mexico. In this case, outsourcing led to dismissing 456 jobs of the 696 jobs before.*

Although it is not always the case, the dismissal of employees could be the result of outsourcing production facilities. Whether or not the dismissal of employees is necessary, depends on the chosen outsourcing strategy. When an organization considers the prevention of dismissal of employees of great significance, they might prefer using a production strategy in ownership.

The third and fourth interfering factors are the **culture barrier** and the **communication barrier**. Culture fit and language barriers are very important factors during offshore outsourcing (Qu & Brocklehurst, 2003). The language barrier and the culture fit are two of the most serious obstacles preventing China from entering the offshore outsourcing supplier market (Lui, 2002 in Qu & Brocklehurst, 2003). Organizations that expect a culture barrier and a communication barrier by outsourcing, will probably choose a different strategy than organizations that do not expect these barriers. An organization that expects a high culture and communication barrier will prefer a national outsourcing strategy.

Till now, the culture barrier and communication barrier have been discussed as interfering factors, which means that the organization considers a possible culture barrier and communication barrier during the outsourcing strategy decision. However, according to a number of authors, some organizations do not take the culture fit and communication barrier into account during the outsourcing decision but do experience these barriers after a while (Huizinga, Mulder, & Zweers, 2003; Khan & Fitzgerald, 2004). For this research, it is assumed that organizations consider the culture barrier and communication barrier during the outsourcing decision and that therefore these variables could influence the outsourcing strategy.

### Propositions

Interfering factors are regarded as factors that discourage organizations from outsourcing production. Therefore, it is assumed that organizations with a high focus on the interfering factors, keep the production in ownership and keep control over the production process. Furthermore, regarding the variable expecting a culture barrier and the variable expecting a communication barrier, producing in national locations seems to have a preference.

*5. Compared with organizations that do not focus on interfering factors, organizations with a higher focus on interfering factors*

*a: produce more often in **ownership***

*b: **keep control over** the production*

*6. Organizations that expect a culture barrier and a communication barrier produce more often on **national locations***

## 2.6 Physical, hardware side of production systems

MacCarthy & Fernandes (2000) created a multi-dimensional classification system (MDCS), for selecting or designing appropriate production planning and control systems (PPC). According to MacCarthy & Fernandes, their MDCS represents a solid framework to capture all characteristics of most production systems from the perspective of PPC. The variables used in the MDCS (Table 2) are based on pioneering classifications and attributes that are perceived as important in production systems, see Appendix A and Appendix B.

The pioneering classifications are job shop, batch shop, line flow, and continuous flow shop (Hayes & Wheelwright, 1979). An overview of two extreme process choices is presented in Table 3 (Safizadeh, Ritzman, Sharma, & Wood, 1996).

**The multi-dimensional classification systems (MDCS)**

<b>General characterization</b>	Enterprise size
	Response time
	Repetitiveness level
	Automation level
<b>Product characterization</b>	Product structure
	Level of customization
	Number of products
<b>Processing characterization</b>	Types of buffer
	Type of layout
	Types of flow
<b>Assembly characterization</b>	Types of assembly
	Types of work organizations

Table 2: The MDCS (MacCarthy & Fernandes, 2000)

	<b>Job Shop</b>	<b>Continuous Flow Shop</b>
<b>Demand Characteristics</b>	Uncertain	Certain
	Heterogeneous	Homogeneous
	High variance, low volume	Low variance, high volume
	Frequent design changes	Slow design changes
<b>Principal Competitive Priorities</b>	Shorter life cycles	Longer life cycles
	Customization	Efficiency
	High performance design	Consistent quality
		Low unit cost
<b>Process Type Attributes</b>		Timely delivery
	Flexible	Rigid
	General Purpose Equipment	Special Purpose Equipment
	Low fixed cost	High fixed cost
	High variable cost	Low variable cost
	Low change-over cost	High change-over cost
	Low degrees of automation	High degrees of automation

Table 3: Demand characteristics, principal competitive priorities, and attributes of the two extreme process choices

Job shop and batch shop are characterized by flexibility and the capability to produce high-performance design. These types of production batches are often used in an environment where the organization decides to compete in a market characterized by the uncertainty related to product variants (**customization**) and low volumes (**production size**) (Hayes & Wheelwright, 1979).

These organizations must use general-purpose equipment and a multi-skilled work force (**knowledge intensive**), grouping resources around the process.

Line flow and continuous flow shop organizations are characterized by efficiency and consistent quality. These types of production batches are used by organizations that decide to compete in a market, characterized by high-volume demand (**demand fluctuation**) for a standardized product (**customization**). Line flow and continuous flow shop organizations tend to use automated (**automation level**), special-purpose equipment, grouping resources around the product (Hayes & Wheelwright, 1979). The decision of the type of production batch is determined by the characteristics of the markets served (Safizadeh et al., 1996).

Considering the MDCS and the characteristics of the pioneering classifications (job shop, batch shop, line flow, and continuous flow shop), the following variables are regarded as physical production system characteristics:

- **Production size**
- **Automation level production process**
- **Process knowledge**
- **Customization**
- **Demand fluctuation**

### 2.6.1 Production size

The production size is defined by three variables. The first one is the **size of production batches**. Hull & Collins (1987) emphasize the statement that mass production is usually produced in a more standardized production process than unit production. The standardization of a production process could influence the outsourcing strategy.

The second variable concerns the **repetitiveness of production batches**. The influence of repetitiveness of production batches on the outsourcing strategy, corresponds with the influence of the size of production batches. A high level of repetitiveness of production batches moves toward more standardized processes. A repetitive production process is less likely to cause unexpected problems and bottlenecks, and permits developing long-term contracts with suppliers. Organizations with a low repetitive production process keep less inventory, whereas organizations with a high level of repetitiveness keep a higher inventory to allow reasonable product variety with quick response times (Safizadeh et al., 1996). An example is used to verify the influence of repetitiveness of production batches:

*When organization A outsources production to organization B, they make some appointments, considering price, quality, delivery time etc. Usually, these appointments are written in a contract. When organization A has a lot of repeat orders, they do not need again a lot communication with organization B, because contracts are already there. Besides, when the repetitiveness increases, the standardization of the production process increases.*

This example illustrates that standardized production processes are more attractive for outsourcing.

The last variable considering production size is the annual **production volume**. It is assumable that repetitiveness of production batches is related to the production volume. However, MacCarthy & Fernandes (2000) argued in a report of APICS, which also associated repetitiveness with production volume of discrete items: the larger the volume, the more repetitive the production system is considered to be. According to MacCarthy & Fernandes, a production system that produces only one product, with a very large processing time, must also be regarded as repetitive, although the production volume is very low.

The product volume heavily influences the decision on process choice (Hayes & Wheelwright, 1979). Safizadeh et.al. (1996) present empirical results supporting these relationships.

### Proposition

Large production sizes suggest a high annual volume and large repetitive production batches. It is assumed that these large production sizes could be produced in a more standardized way than single pieces. It could be advantageous to outsource production processes, with a high level of standardization, to LCC. Although the production is outsourced, the organization still needs control over the production. Therefore, it is suggested that a difference in production size does not have a different influence on the level of control.

*7. Compared with organizations with a small production size (small annual volume, non-repetitive, small batches), organizations with a larger production size*

*a: **outsource** production more often*

*b: outsource more often to **international locations***

## 2.6.2 Automation level production process

The first variable considering the automation level of production processes is the **level of automated operations**. The automation level of the production process relates to the control of the production systems (Bright, 1958 in MacCarthy & Fernandes, 2000). Automation can be defined as a technology concerned with the application of mechanical, electronic and computer-based systems to operate and control production (Groover, 2000). The automation level provides insight into the extent to which the production process is automated. The following types are proposed (Groover, 2000; MacCarthy & Fernandes, 2000):

- *Normal automation* is characterized by a high degree of participation by the employee, at the operational or execution level. Normal automation includes classical flow-shop and job-shops, cellular manufacturing systems with flow shop characteristics and cellular manufacturing systems with job-shop characteristics. Groover (2000) describes this as a manual process.
- *Flexible automation* has, at the operation or execution level, computer control taking the main role by means of technologies, e.g. local area networks and computer numerical control, and will often be accomplished by some form of flexible manufacturing system technology. Groover (2000) described this kind of automation as semi-automated.
- *Rigid automation* is characterized by highly specialized and dedicated automatic equipment and is found in transfer lines. This kind of automation is defined as automated by Groover (2000).

The level of automation involves the number of employees and the standardization of the production process. A preference for an international or national location could not be suggested, because the level of automation does not influence the location variable.

Groover (2000) proposed a distinction between processing operations and assembly operations. Therefore, the second variable which describes the production process is the level of assembly. The level of assembly influences the outsourcing strategy. According to Fine and Whitney (1996) this is due to the degree of decomposability: some products are easily decomposable and others cannot be decomposed. The degree of decomposability influences the design process and has an impact on outsourcing decisions as well. The most easily decomposable (and therefore decomposed) components are the best candidates for outsourcing (Fine & Whitney, 1996). Fine & Whitney (1996) proposed a matrix of dependency and decomposability. This matrix compares the level of assembly (decomposable and integral) with dependency for knowledge and capacity.

	DEPENDENT FOR KNOWLEDGE	DEPENDENT FOR CAPACITY
OUTSOURCED ITEM IS DECOMPOSABLE	<p><b>A potential outsourcing trap</b> Your partners could supplant you. They have as much or more knowledge and can obtain the same elements you can.</p>	<p><b>Best outsourcing opportunity</b> You understand it, you can plug it into your process or product, and it probably can be obtained from several sources. It probably does not represent competitive advantage in and of itself. Buying it means you save attention to put into areas where you have competitive advantage, such as integrating other things.</p>
OUTSOURCED ITEM IS INTEGRAL	<p><b>Worst outsourcing situation</b> You don't understand what you are buying or how to integrate it. The result could be failure since you will spend so much time on rework or rethinking.</p>	<p><b>Can live with outsourcing</b> You know how to integrate the item so you may retain competitive advantage even if others have access to the same item.</p>

Table 4: Matrix of dependency and outsourcing (Fine & Whitney, 1996)

Automated assembly processes require fewer employees compared with non-automated assembly processes. In order to clarify the relation between the level of assembly (manual, automated) and outsourcing strategies, the level of assembly has been divided into two parts:

- **Level of automated assembly**
- **Level of manual assembly**

### Proposition

Assembly and production processes that are highly automated require fewer employees and outsourcing will not deliver high employee cost reductions. Therefore, it is suggested that automated production processes will be kept in ownership and under own control.

It could not be inferred whether or not the automation level of production processes influence the location variable.

8. Compared with organizations that have a low automated production process, organizations with a higher level of automation

a: produce more often in **ownership**

b: **keep control over** the production

### 2.6.3 Process knowledge

In order to create an impression of the knowledge intensity of the production process, three variables are examined. First of all, the variable concerning **complexity of the process** is used. Novak & Eppinger (2001) conducted a study to determine the relationship between the complexity of production systems and outsourcing strategies in the auto industry. Given their observations, organizations benefit when concentrating production of complex systems in-house and outsourcing simpler systems, efficiency arguments suggest that profit-maximizing firms should only operate according to these approaches (Novak & Eppinger, 2001).

Complex Product Systems (CoPS) have been defined as 'high cost, engineering intensive products, sub-systems, or constructs supplied by an unit of production' (Hobday, 1998). According to Prencipe (1998), CoPS identify a group of products that differ from simpler, mass produced products in terms of the dynamics of the innovation process, competitive strategies and industrial co-ordination.

Four characteristics set CoPS apart from mass-produced goods (Hobday, 1998):

1. They are high cost systems composed of many interacting and often customized elements
2. Their design, development, and production usually involve several firms
3. They exhibit emerging and unpredictable properties
4. The degree of user involvement is usually very high

The second and third variables are based on the education level of the employees that are involved in the production process. The education level is split up into the **education level of the operators** and the **education level of the process controllers**.

The education level of employees is related to the skills which are needed to carry out the production activities. In literature, authors have different opinions about the relation between skill level and outsourcing strategy. According to Anderton & Brenton (1999) low skill intensive parts of production are often outsourced to LCC, due to the low cost of labor. Low skill intensive parts of production are often standardized production activities. High skill intensive activities are produced in-house. Egger & Egger (2003) provide a theoretical model where an organization may produce either nationally or internationally, using low-skilled and high-skilled labor at home, or by outsourcing (part of) their intermediate input production across borders, using low-skilled labor abroad and only high-skilled labor at home.

#### Propositions

With reference to the mentioned literature, it is advisable to keep knowledge intensive processes in ownership, and outsource non-knowledge intensive processes. Production processes that require a low education level of employees are often outsourced to LCC.

Therefore, the following propositions are formulated:

9. Compared with low knowledge intensive production processes (low complexity, low education level operators, low education level process controllers), highly knowledge intensive production processes

a: produce more often **ownership**

b: keep more **control** over the production

10. Low knowledge intensive production processes are more often located in **international** organizations.

#### 2.6.4 Customization

Fine and Whitney (1996) distinguish strongly between products with a modular architecture of which the components can be 'mixed and matched' due to 'the standardization of function to some degree and standardization of interfaces to an extreme degree' and products showing, instead, an integral architecture, where 'components and subsystems are designed to fit within each other'. An example of a modular architecture is home-stereo equipment, where one could choose for a cd-player from one supplier, and speakers from another supplier. Integral architectures are for example airplanes. The components of airplanes are not off-the-shelf parts. The **level of customer influence** is defined by the extent that a customer influences the design of the product. In the logistic area, the disconnection point indicates where the order gets customer made (Fröhlich & Platje, 2000). The disconnection point splits the organization into two parts: a part focused on consumer orders (front end) and a part focused on the planning (back end). At the disconnection point, there is often a stock buffer constructed to respond to the dynamic demand without eroding the flat production pattern. The positioning of this disconnection point is determined by the delivery by the end consumer and by determining the place where the variability in the demand begins to dominate. The disconnection point makes it possible to distinguish between the dynamic demand and the rigid production planning. As a result, a different supply chain can be used before and after the disconnection point. Before the disconnection point, a more efficient supply chain is preferable (Mason-Jones, Naylor, & Towill, 2000), whereas after the disconnection point a more reactive one is preferred. The difference in supply chain influences the outsourcing strategy.

Another variable that characterizes the customization is **keeping buffers**. An organization could strategically choose for a system that is make-to-stock or make-to-order (Naylor, Naim, & Berry, 1999). Customer specific products are produced on demand unlike most standardized products. Standardized products could be produced for stock, which shortens the delivery time. Apart from the relative short reaction time, it provides the organization with the possibility to outsource production abroad, because due to the buffer, direct delivery from the producer is not necessary.

An example is presented:

*When organization A produces for stock, the organization keeps a buffer of the products which results in a relative short reaction time to the customer.*

*When there is a delay in the production process, the organization still has a buffer. In contrast, when organization A produces on order, delays in the production process results in the temporary inability to deliver the products.*

### Proposition

Customer specific products require more communication and shorter communication lines than standardized products (a reactive supply chain is preferred). Customer specific products are made-to-order, and it is almost not possible to keep a buffer for customer specific products. Therefore, it can be concluded that with customer specific products there is preference for national production locations, production in ownership and this requires control over the production.

*11. Compared with organizations that produce non-tailor-made products, and organizations that keep buffers, organizations that produce tailor-made products and keep no buffers have*

*a: more production in **ownership***

*b: more **control** over the production process*

*c: more production in **national** locations*

### 2.6.5 Demand fluctuation

Demand dynamics could be caused through **seasonal influences** or **sensitivity to market economy** involving the economic cycle (expansion, prosperity, contraction, recession). Yang, Qi & Xia (2005) proposed a few methods for organizations to react on these fluctuations. The first method to react on these fluctuations is: to keep a buffer. A disadvantage of keeping a buffer are the high costs it entails. Another measure to deal with fluctuation is a flexible production system. A flexible production system could be realized by using machines with an overcapacity. However, during a period of a lack of employees, this method is also capital intensive. A cheaper method for creating a flexible production system could be achieved through outsourcing. When the demand rises, outsourcing follows. In this way, the risk of a lack of employees is passed on to suppliers.

### Proposition

Producers of products with a high fluctuation in demand need to be flexible. This requires control over the production, and a relatively short reaction time. To reach flexibility, organizations could choose for capacity outsourcing (Fine & Whitney, 1996). This means that the organization produces in ownership. Due to the required short reaction time, a national production location seems preferable.

*12. Compared with organizations that produce products with a low fluctuation of demand, organizations that produce products with a high fluctuation of demand*

*a: produce more often in **ownership***

*b: keep more **control** over the production*

*c: produce more often in **national** locations*



### 3 Research methodology

This chapter outlines the research methodology. The goal of this research is to test the propositions that are formulated in chapter 2. This chapter outlines the research design, the sample selection, the questionnaire construction and first analysis. Finally, the validity of the research will be discussed.

#### 3.1 Research approaches

The propositions can be discussed by using quantitative data or qualitative data. Quantitative and qualitative research approaches clearly differ in terms of how data are collected and analyzed. Quantitative research requires the reduction of phenomena to numerical values in order to carry out statistical analysis (Gelo, Braakmann, & Benetka, 2008). Babbie (1998) described quantitative analysis as the numerical representation and manipulation of observations for the purpose of describing and explaining the phenomena that those observations reflect. Qualitative research involves collection of data in a non-numerical form, for example texts, pictures, videos, etc. Gelo, et al. (2008) proposed attributes of quantitative and qualitative approaches, see Table 5.

Quantitative approaches	Qualitative approaches
<b>Nomothetic</b>	<b>Idiographic</b>
Extensive	Intensive
Generalizing	Individualizing
<b>Explanation</b>	<b>Comprehension</b>
Prediction	Interpretation
Generalization	Contextualization
<b>Deduction</b>	<b>Induction</b>
Theory-driven	Data-driven
Hypotheses-testing	Hypotheses-generating
Verification-oriented (confirmatory)	Discovery-oriented (exploratory)
<b>Experimental</b>	<b>Naturalistic</b>
True-experiments	Case-study (narrative)
Quasi-experiments	Discourse analysis
	Conversation analysis
<b>Non-experimental</b>	Focus group
Correlational	Grounded theory
Correlational-comparative	Ethnographic
Correlational-causal-comparative	
Ex-post-facto	<b>Internal validity</b>
	Descriptive validity
<b>Internal validity</b>	Interpretative validity
Statistical conclusion validity	Explanatory validity
<b>Construct validity</b>	<b>Generalizability</b>
Causal validity	Transferability
<b>Generalizability</b>	
External validity	

Table 5: Attributes of quantitative and qualitative methodologies (Gelo et al., 2008)

Almost all attributes of the quantitative approach are applicable on this research. First of all, this research consists of the establishment, collection and assimilation of facts with the exclusive aim of recognizing and formulating laws that are always applicable. This refers to a **nomothetic** approach (Gelo et al., 2008). **Explanation** represents the establishment of connections between facts through regularities which are observed. The opposite is comprehension which is the reconstruction of how someone else has established connections between facts through regularities they observed (Köckeis-Stangl, 1980 in Gelo et al., 2008). The data gathered in the research are used to establish facts which reject or accept the propositions. This also indicates the **deductive** character of the research, which means a theory driven research. The propositions are formulated on the basis of the literature.

In this research, the independent variables cannot be manipulated because the production system characteristics of an organization are fixed, which make a **non-experimental** design preferable (Gelo et al., 2008). The basis of the research is to explore the relation between production systems and outsourcing strategies, correlations between the characteristics of the dependent and independent variables plays a major role. This complements the **correlational design** of non-experimental research. The aim of this research is a general applicable framework, and therefore the **external validity** is of major importance. A last additional advantage of quantitative research is that large sample sizes could be analyzed.

## 3.2 Quantitative research design

As for the characteristics presented in section 3.1, a quantitative approach is preferable. Therefore, a quantitative research has been executed.

### 3.2.1 Research method

In most cases a survey research is used for quantitative data gathering (Gelo et al., 2008). Reasons for choosing survey research are (Gelo et al., 2008):

- Survey research is cheaper and quicker than for example, face-to-face interviews
- Surveys are flexible; many variables can be asked
- Greater accuracy in measurement

However, apart from advantages of survey research, a few disadvantages could be found. Relevant data could be missed by using survey research, because reacting on given answers is not possible. Furthermore, it could not be checked if the right person has filled in the survey, and in what kind of mood the respondent was. If the respondent was in a hurry, he could have made some mistakes in reading the questions, and in answering them.

The survey research could be executed through different methods. All survey research methods have their pros and cons considering costs, reaction time and response rate. The following methods are proposed:

- Distributing a paper version of the questionnaire by mail, accompanied with a covering letter and a self-addressed, stamped envelope for returning the questionnaire
- Distributing a paper version of the questionnaire in person, and collecting the filled questionnaires in person

- Distributing an e-mail which direct includes the questions
- Distributing an e-mail which includes a link to another website where the survey is presented

In the light of this research, the survey has been executed by distributing an e-mail which includes a link to another website where the survey was presented. This website ([www.enqueteviainternet.nl](http://www.enqueteviainternet.nl)) is used to create the survey and to collect the data. An advantage of using the survey website is that due to the tools of the survey website a professional questionnaire could be made. These tools also provide a user-friendly filling in of the questionnaire. More reasons for this decision are the preferred short response time and the relative low costs. However, some disadvantages could be found. As mentioned before, it is possible that the wrong person receives the email with the survey. Furthermore, it could not be checked how seriously the respondents answered the questions. These disadvantages cannot be prevented, but considering the subject, a serious response could be expected.

### 3.2.2 Sampling

The quantitative research consists of a survey research and is accomplished in cooperation with FME-CWM. FME-CWM is an employers' association for the technological-industrial sector and has 2.750 member organizations. FME-CWM is built on three pillars: management, provision of services, and sector organizations. The cooperation of FME-CWM is performed from the provision of services department.

The target group of the research consisted of profit making production organizations in the technological-industrial sector. An example could be the producer of automotive products. The activities of these organizations consist of engineering, production, trade, industrial maintenance and industrial automation, and they are member organizations of the FME-CWM organization. In these organizations, the responsible manager for production strategies has been approached to cooperate with this research.

Due to the large target group, a sample of organizations had to be made. Convenience sampling was used, which is a form of purposive sampling that is often used in quantitative research designs (Gelo et al., 2008). The organizations have been chosen randomly out of the member list of FME-CWM. The sampling of the organizations consists of taking the first organizations of an alphabetical ordered list. In total, 1164 organizations were invited to contribute to this research.

In order to create a high response rate, a covering letter of FME-CWM was sent. In this letter, the necessity of research on outsourcing was emphasized (Appendix C). Furthermore, the results of the study will indirectly be used to advise the member organizations of FME-CWM. By emphasizing the importance of research on outsourcing, and by emphasizing the advantages for the respondents, a positive response was expected.

### 3.2.3 Questionnaire construction

In quantitative research, data have to be collected which are relevant for the testing of the formulated hypotheses (Babbie, 1998). Quantitative data collection is attained by using standardized questionnaires, structured interviews and closed-ended observational protocols.

#### Independent variables

According to Babbie (1998), close-ended questions provide a greater uniformity of responses and are more easily processed than open-ended ones. For most of the variables a five-item Likert scale is used. A Likert scale ranges from: strongly agree to strongly disagree with a neutral response in the middle (Maurer & Pierce, 1998). The questionnaire is based on a combination of this research and a research of FME-CWM.

The questionnaire is based on the dependent variables of the generic production system:

1. Organizational characteristics
2. Managerial, soft side characteristics
3. Physical, hard side characteristics

#### 1. Organizational characteristics scale

The organizational characteristics are measured by fixed answers.

The intervals for the number of employees are set on (MacCarthy & Fernandes, 2000):

- < 50
- 50 - 250
- > 250

The intervals for turnover are set on:

- < 10 million
- 10 - 50 million
- > 50 million

The variable market location is operationalized by:

- National
- International
- Both, national and international

#### 2. Managerial, soft side characteristics

The first part consists of propositions about the strategy of the organization. To what extent does the organization focus on the strategy factors? The scaling of these questions consists of 5 items, with 5 for strong focus and 1 for no focus.

#### 3. Physical, hard side characteristics

The second part consists of propositions about the production characteristics. To what extent are the variables applicable on the product, production process and market factors? The scaling of these questions again consists of 5 items, only now with 5 for strongly applicable and 1 for not or hardly applicable.

## Dependent variables

As described, the dependent variables of the outsourcing strategies are:

1. Management (ownership)
2. Control
3. Location

### 1. Management (ownership)

The second dependent variable is management. The dependent management variable is split up into 'production in ownership' and 'outsourcing production'. The reason for this splitting up is that organizations could produce in ownership, and at the same time outsource a part of the production. The level of ownership is measured on a 5 item Likert scale:

1. The organization produces the product in ownership
2. The organization outsources the production of the product

### 2. Control

The last dependent variable is control. The level of control is measured on a 5 item Likert scale, the question used for measuring control is:

1. The organization has full control over the production process

### 3. Location

Due to the research of FME-CWM, the outsourcing locations are split up per country. A fixed scale with the following countries is used: East Europe, Russia, South Europe, North West Europe, Netherlands, South East Asia, Asia, United States, Latin America.

It is also possible to fill in 'elsewhere, namely...'. By adding this last possibility, the survey is more exhaustive (Babbie, 1998).

For this research, the splitting up into different countries is not necessary, therefore, the location variable is defined by national, international and national/international:

- **National:** Netherlands
- **International:** East Europe, Russia, South Europe, North West Europe, South East Asia, Asia, United States, Latin America
- **National and international**

The 'national and international' item is included because it is possible that organizations produce nationally as well as internationally.

The complete questionnaire is presented in Appendix C.

### 3.2.4 First analysis

The extensive findings of the research are presented in chapter 4. However, because the responses of the quantitative research were pretty disappointing, a first analysis is presented in this section. Possible causes of the low response are discussed in the limitations of this research section 0.

#### Responses

In total 1164 organizations were invited to cooperate with this research. These organizations were approached in three parts. First a group of 150 organizations were invited which resulted in 6 responses, the second group consisted of another 500 organizations which resulted in 7 responses. Because of this low response rate, another 514 organizations were invited to cooperate, but again with 9 responses a low response rate was achieved.

Due to the low response rate, it was decided to approach organizations face-to-face. By handing over the questionnaire in person and asking the organizations to cooperate, the following advantages were achieved:

- Attainment of a higher response rate
- A decrease in the number of missing values in questionnaire
- Clarification of misunderstandings
- The respondent could be observed, and questions could be asked as reaction to answers

These advantages will partly compensate the disadvantages of the previous survey research. The research was executed on the InfraTech 2009 fair. The InfraTech fair is the meeting place for everybody who is involved in soil, hydraulic and highway engineering, that is, infrastructure. The InfraTech fair took place in Ahoy Rotterdam. The exhibitors of the InfraTech fair ranged from site agents to those who take the final decisions, from contractors to those who define policy and from customers to those who implement projects. Providers from various market segments were present.

Again a purposive sample selection was used (Babbie, 1998). Purposive sampling is especially useful because different branch organizations are presented on the fair and by non-probability sampling the units to be observed are selected on the basis of the researcher's judgment. For the face-to-face research only production organizations were selected. This means, that service suppliers and government organizations were not selected. Four organizations were especially relevant for this research and cooperated by filling in the questionnaire.

As a result of sending the questionnaire by email, and the face-to-face interviews on the fair, 26 organizations cooperated with this research. On a number of questionnaires, data were lacking, which resulted in 18 useful responses.

### 3.2.5 Data analysis

Due to the high amount of variables, the analysis is based on the categories of Figure 9 (organization size, market focus, motivation factors, interfering factors, production size, automation level production process, process knowledge, customization and demand fluctuation).

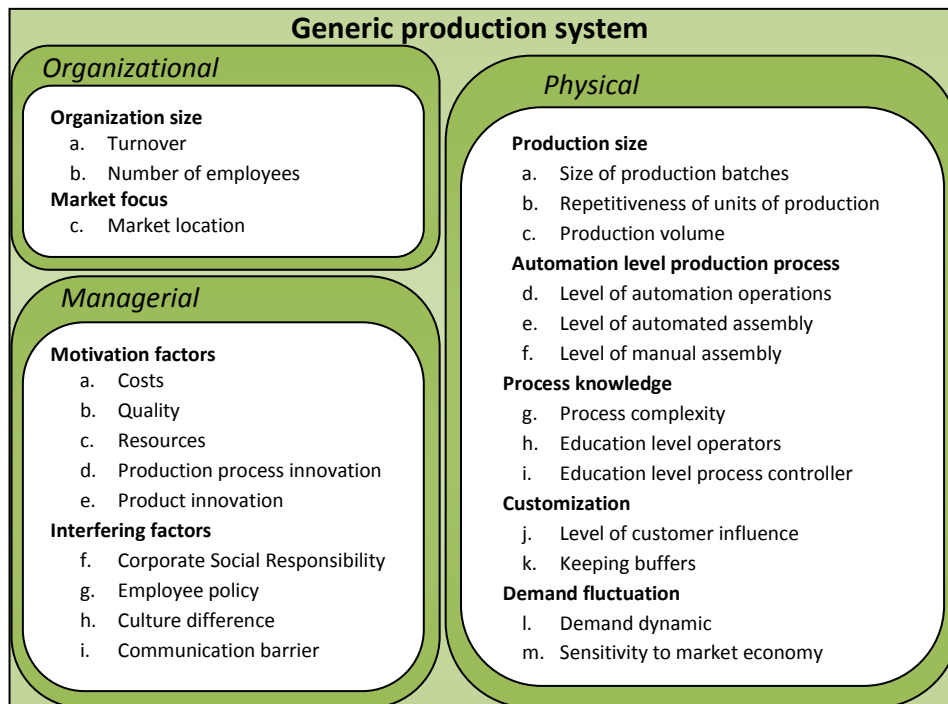


Figure 9: Subcategories generic production system

Because of the low response rate, Microsoft Excel 2007 was used instead of SPSS (Statistical Package for the Social Sciences). The rating of the independent variables resulting from the questionnaire was based on the five-item Likert scale. Due to the low number of data, it was decided to take 'strongly agree' and 'agree' together as 'agree'. Likewise, 'strongly disagree' and 'disagree' are taken together as 'disagree'. Neutral responses are still taken as neutral.

After generalizing the rating of the independent variables in 'agree', 'neutral' and 'disagree', the average rating of the dependent variables was calculated.

#### Dependent management and control variable

The dependent management and control variables consisted of the following variables, referring to the questionnaire construction of section 3.2.3:

- Level of production in ownership
- Level of outsourcing production
- Level of control over production

The management variables were rated on a five-item Likert scale. For every rating of the independent variable ('agree', 'neutral' and 'disagree'), the average rating of the dependent variable was calculated. In the example below, organizations with a high level of automation, have a average rating of 3,50 for control over production (red square in Table 6).

An example of rating for level of automation is shown below:

<i>Automation level</i>	#	Level of ownership	Outsource production	Control over production
<b>Automation level</b>				
Low level of automation	6	1,67	3,50	1,83
Medium level of automation	6	2,33	4,67	1,50
High level of automation	6	3,67	3,17	3,50
<b>Manual assembly</b>				
Low level manual assembly	12	2,42	4,00	2,17
Medium level manual assembly	1	3,00	3,00	2,00
High level manual assembly	5	2,80	3,40	2,60
<b>Automatic assembly</b>				
Low level automatic assembly	4	3,00	3,00	3,00
Medium level automatic assembly	2	2,00	4,00	2,00
High level automatic assembly	12	2,50	4,00	2,08

Table 6: Example, rating of dependent management and control variable

With the help of these tables, graphics are created like, Figure 10, Figure 11, and Figure 12.

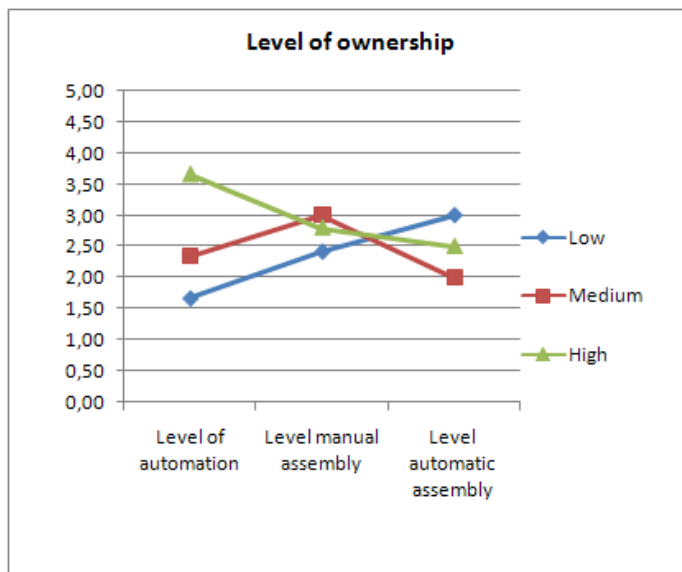


Figure 11: Example, influence automation level on level of ownership

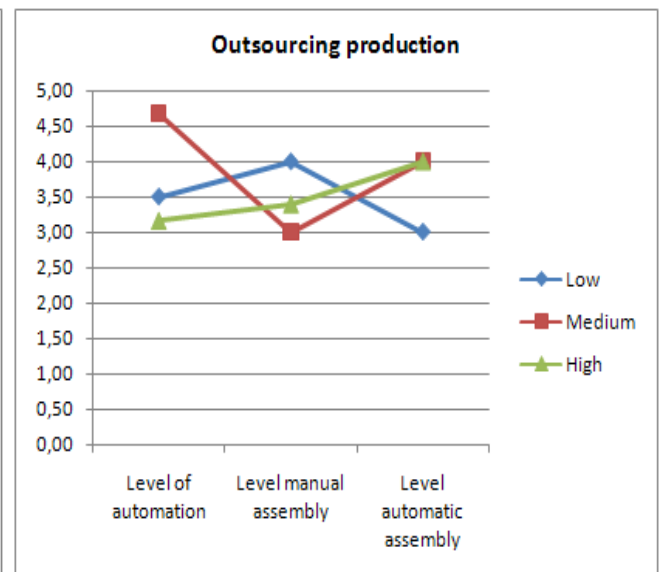


Figure 10: Example, influence automation level on level of outsourcing



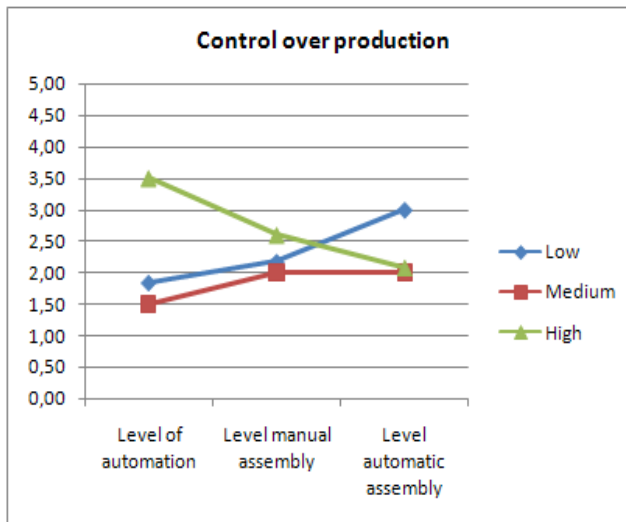


Figure 12: Example, influence automation level on level of control

Based on the graphics like Figure 10, Figure 11, and Figure 12, an analysis is written about the relation between the independent variables, and the dependent management and control variables.

#### Dependent location variable

The second dependent variable 'location', was measured by:

- National
- International
- International and national

It was calculated in percentages, to what extent the organizations produce internationally or nationally. For example, organizations with a low automation level of the production process, all produce internationally, 83% produce internationally, and 83% produces both internationally and nationally (see green squares in Table 7).

	International	National	International and national
<b>Automation level</b>			
Low level of automation	100%	83%	83%
Medium level of automation	100%	50%	50%
High level of automation	83%	83%	67%
<b>Manual assembly</b>			
Low level manual assembly	100%	75%	75%
Medium level manual assembly	100%	0%	0%
High level manual assembly	80%	80%	60%
<b>Automatic assembly</b>			
Low level automatic assembly	75%	75%	50%
Medium level automatic assembly	100%	50%	50%
High level automatic assembly	100%	75%	75%

Table 7: Example, influence automation level on location

Again, based on these tables, graphics are created ( Figure 13).

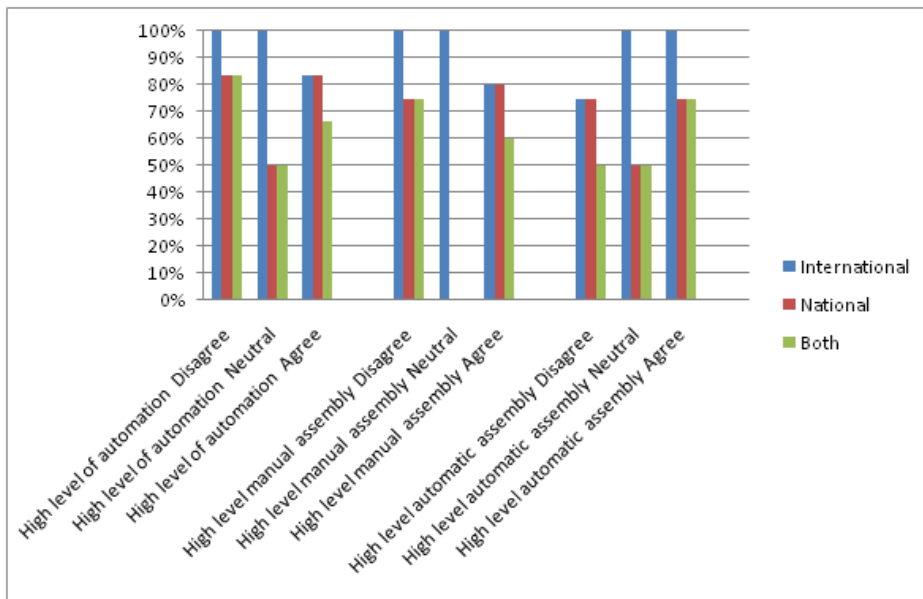


Figure 13: Example figure, influence level of automation on the dependent location variables

### 3.3 Validity

Validity refers to the approximate truth of an inference (Shadish, Cook, & Campbell, 2002). The validity of this research refers to the relation between the independent and dependent variables.

The validity is discussed by the following types:

- Statistical conclusion validity
- Internal validity
- Construct validity
- External validity

#### 3.3.1 Statistical conclusion validity

The statistical conclusion validity concerns the validity of inferences of correlation. This validity describes two points: whether the dependent variables and the independent variables correlate, and how strongly they correlate (Shadish et al., 2002). The statistical conclusion validity is an important aspect of this research, because this research is about the relation between the independent production system variables and the dependent outsourcing strategies. Whether or not a relation exists, and the actual strength of that relation is of great relevance. Shadish et al. (2002) proposed nine threats to statistical conclusion validity, here only those threats which are relevant to this research are discussed.

##### 1. Low statistical power

Due to the low response rate of the research, it is possible that the analysis gives a distorted image. To prevent large distorted images, variables that are rated by only one respondent are omitted in the analysis of the findings.

## 2. Fishing and the error rate problem

Again, due to the low response rate, there is a risk of manipulating the data, till one come to an interesting conclusion. To prevent this 'fishing and the error rate problem', the work methods of the analysis will be the same for all variables.

## 3. Unreliability of measures

Despite adding a clear letter to the questionnaire, in which the importance of the research was emphasized, it is still possible that measures were unreliable. This is due to the fact that only 18 of the 26 responses could be used. Reasons for not answering the questions probably could be the time at which the questionnaire was sent. It was sent around Christmas and New Year. In this time period, a lot of organizations are busier than normal due to holidays.

### 3.3.2 Internal validity

Internal validity refers to inferences about whether observed co-variation between A and B reflects a causal relationship from A to B in the form in which the variables were manipulated or measured (Shadish et al., 2002). This research consists of exploring the relation between two main subjects: production systems and outsourcing strategies. Although the responses were relatively disappointing, it has been attempted to minimize the threat of internal validity by using two methods of quantitative data gathering: surveys and face-to-face interviews. Furthermore, variables which were rated by only one respondent have been omitted from this research. This prevents one-sided ratings. The variables omitted from this research are:

- National market location
- Medium level of manual assembly
- High education level process controller

### 3.3.3 Construct validity

The construct validity concerns the match between study operations and the constructs used to describe those operations (Shadish et al., 2002). The main reason for this is the inaccuracy. The topics of the propositions are not based on the opinion of the respondent but on the facts of the production system and the strategy of the organization. Therefore, it is proposed that a questionnaire is still preferable, but the questions need to be clearly phrased.

A second aspect of inaccuracy is that a respondent could be asked a question were he has not reflected upon. In this case an answer could be given which is not well-considered. It is hard to prevent this failing, however, the target group of this research was possibly familiar with the questions asked, because these were job related.

### 3.3.4 External validity

External validity concerns inferences about the extent to which a causal relationship holds over variation in persons, setting, treatments, and outcomes (Babbie, 1998). This research took place on an abstract level, which resulted in abstract conclusions. The main reason for choosing a research on an abstract level, is to provide a broad view of the recent trends of outsourcing. These trends provide organizations with a general direction while choosing for the right outsourcing strategy.

Due to the high level of abstraction and the low response rate, it could occur that the model is not applicable for all production organizations, and that specific organizations use a different outsourcing strategy from the one suggested in this thesis. It is advised to use this research for choosing a global outsourcing strategy, and then look at more specific characteristics of the production system and outsourcing strategy characteristics.

### 3.3.5 Conclusion validities

The low response rate was the largest threat for the statistical conclusion validity. A clear reason for this low response could not be found. However, some speculations could be made.

The first surveys were sent just before Christmas and New Year. A vast majority of the organizations is closed around Christmas and New Year. This means that employees need to prepare business for when the holiday ends. Filling in a survey probably did not have a high priority in these times. A second result of this holiday regards a threat of construct validity. The survey was sent by email. When the respondent comes back from the holiday and opens the email, it could occur that a large number of emails are in the inbox of the respondent. Emails which are directly related to the organization will have a higher priority than a survey research.

A third reason may be related to the large number of variables which were asked in this research. Although filling in the survey did not take a lot of time, it could scare off respondents.

The above described speculations could be prevented by sending the survey on a different moment or by sending a reminder. Unfortunately, sending surveys on a total different moment did not fit in the time perspective which was proposed for this research. Regarding the reminder, FME-CWM did decide to send no reminder as a result of the very low first response, this choice is accepted. The large number of variables was due to the large number of variables required for this research and the number of variables required for the FME-CWM research. It was known that the number of variables was large, however it was decided to continue because they were required. By using a Likert scale, filling in the survey was facilitated.

## 4 Findings

This chapter presents the findings of the quantitative research. The methods used for the analysis are described in chapter 3. The findings of the quantitative research are divided into two parts. The first part consists of the demographic characteristics of the responses, the second part consist of the analysis of the influence of the independent variables on the dependent variables.

The second part has the following structure per section:

### Frequency table

Displays the number of responses per dependent variable

### Management and control findings

Influence independent variables on dependent level of ownership variable

Influence independent variables on dependent level of outsourcing variable

Influence independent variables on dependent level of control variable

### Location findings

Influence independent variables on dependent location variables

### Proposition discussion

Discussion of the propositions

## 4.1 Demographic characteristics

The turnover and number of employees are presented in Figure 14. The largest part (9 out of 18) are organizations with 100 – 250 employees. 33% of the organizations have less than 100 employees and 22% has more than 250 employees. As for turnover, the number of organizations with different turnovers are almost equal. 39% have a turnover lower than 10 million, 33% have a turnover between 10 and 50 million, and 33% have a turnover larger than 50 million. With regard to the turnover, the respondents are almost equal. Considering the number of employees, more organizations with a number of employees between 100 and 250 cooperated.

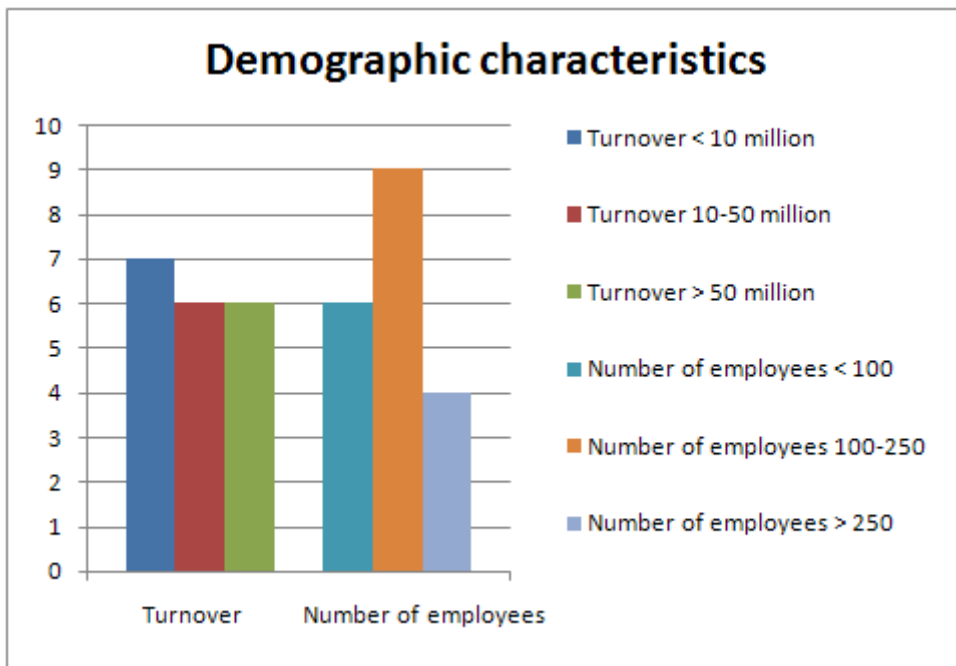


Figure 14: Demographic characteristics of responses

## 4.2 Organizational findings

The organizational variables consist of the organizational size and market focus.

### 4.2.1 Organizational size

#### Frequency table

Variable	Number	Variable	Number
Small turnover < 10 million	7	Small number of employees < 100	6
Medium turnover 10-50 million	6	Medium number of employees 100-250	9
Large turnover > 50 million	6	Large number of employees > 250	4

Table 8: Frequency table organizational size

#### Management and control findings

After analyzing Figure 17, the following could be found. Organizations with a larger turnover than 50 million (large turnover), have more control over their production than organizations with a smaller turnover. The same applies for organizations with a larger number of employees.

Furthermore, it could be concluded that organizations with an medium-sized turnover (10 till 50 million) have the highest rating for 'production in ownership' (Figure 16).

Organizations with a medium-sized number of employees (100-250) outsource less often than smaller and larger organizations (Figure 15).

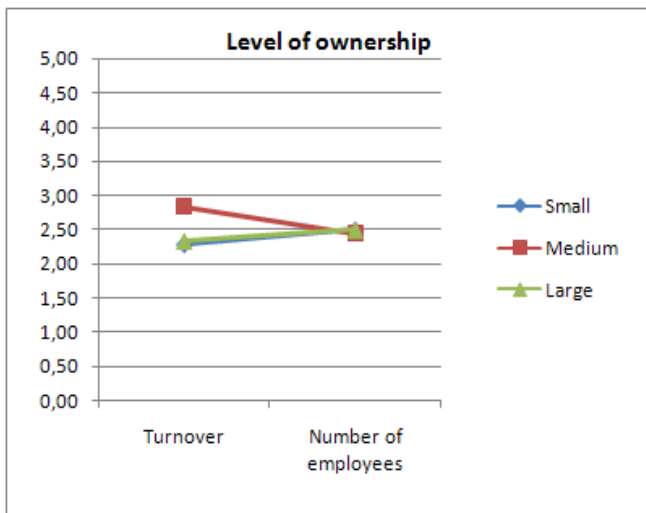


Figure 16: Influence organizational characteristics on level of ownership

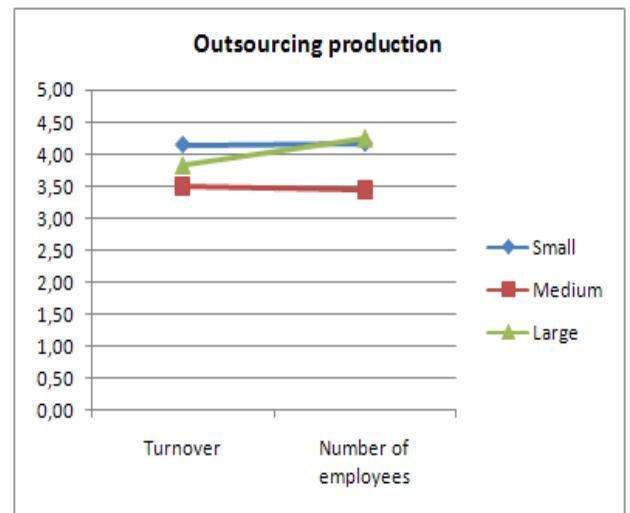


Figure 15: Influence organizational characteristics on level of outsourcing

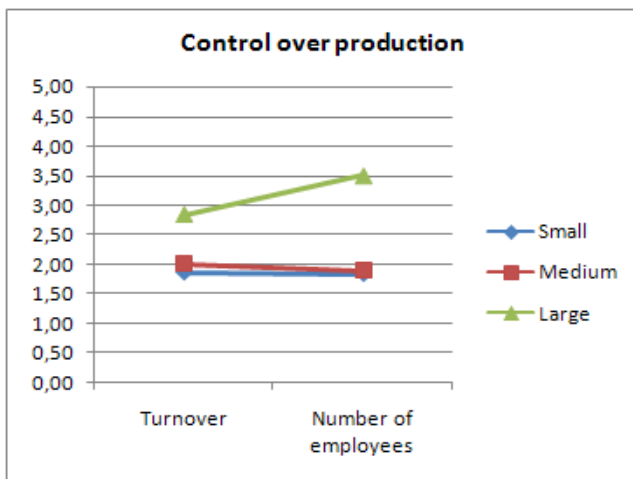


Figure 17: Influence organizational characteristics on level of control

### Location findings

As Figure 18 shows, an increase in the number of employees, results in an increase of international locations. Organizations with more than 250 employees all produce on a national location as well as an international location. Organizations with 100 to 250 employees produce less often nationally, compared with organizations with fewer than 100 employees.

Organizations with a turnover larger than 50 million all produce internationally. Furthermore, organizations with a turnover between 10 and 50 million produce less nationally compared with organizations with a smaller turnover.

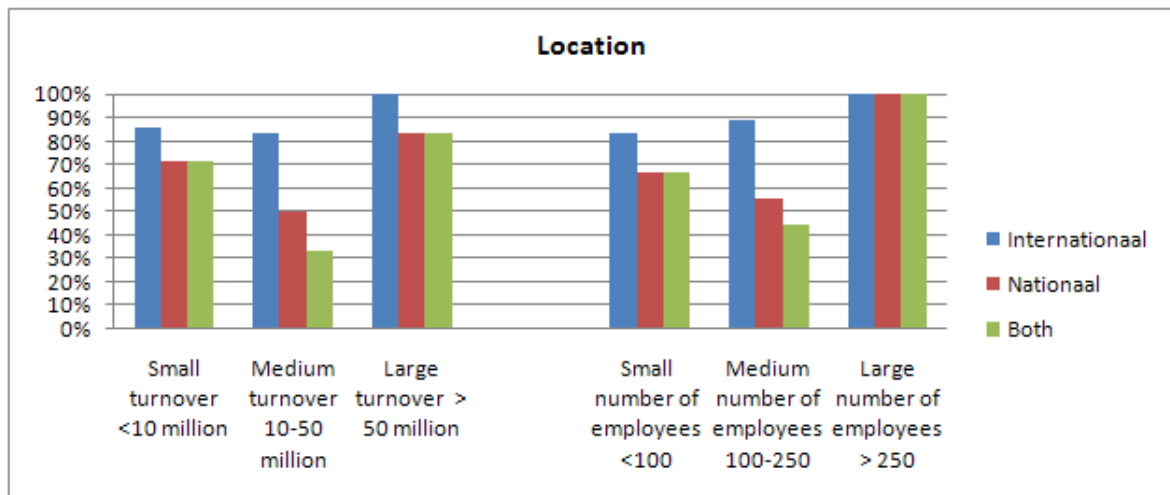


Figure 18: Influence organizational characteristics on location variables

### Proposition discussion

1 Compared with organizations with a smaller turnover and a lower number of employees, organizations with a larger turnover and a larger number of employees

a: produce more often in **ownership**

b: **keep more control** over the production

c: produce more **internationally**

Considering the data, proposition **1a** is rejected, because organizations with a large turnover have no more production in ownership, compared with organizations with a smaller turnover. Organizations with a medium-sized turnover of 10 till 50 million have the most production in ownership. Likewise, organizations with a medium-sized number of employees (100-250) are less occupied with organizations with a higher or lower number of employees. However, these findings do not confirm proposition **1a**.

Proposition **1b** is accepted. Organizations with a larger number of employees and a larger turnover do have more control over the production.

Proposition **1c** is also accepted for the variable concerning number of employees and turnover. Organizations with a larger turnover and a larger number of employees produce more internationally, compared with organizations with fewer employees and a lower turnover.

## 4.2.2 Market location

### Frequency table

Variable	Number
<b>National market focus</b>	1
<b>International market focus</b>	5
<b>National and international market focus</b>	13

Table 9: Frequency table market focus



There was only one organization with a national market focus, which resulted in one-sided answers. Therefore, findings on the national market focus will not be taken into account.

### Location findings

Organizations with an international market focus produce all internationally. Organizations with a national market focus as well as an international market focus produce more nationally, and less often internationally compared with organizations with only an international market focus.

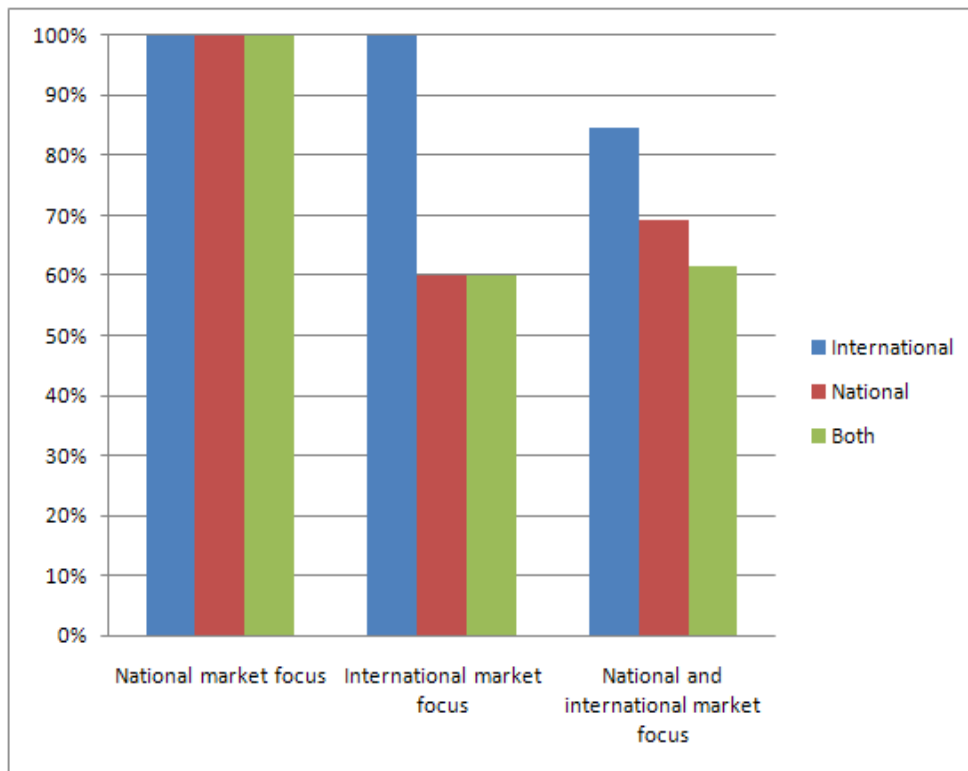


Figure 19: Influence market location on location variable

### Proposition discussion

#### 2. The market focus of organizations is *equal* with the *location* of production

As Figure 19 shows, organizations with an international market focus have indeed located their production on international locations. All these organizations produce internationally, 60% of these organizations also produce nationally. The difference between organizations that produce internationally and organizations that produce nationally is 40%. 84% of the organizations with a national and international market focus produce internationally, 69% of these organizations also produce nationally and 61% produce nationally as well as internationally. The difference between producing internationally and nationally for organizations with both an international and national market focus is 15% (84%-69%).

Organizations with both an international and national market focus, produce relatively more internationally as well as nationally, compared with organizations with only an international market focus proposition. Therefore, **2** is accepted.

## 4.3 Managerial, soft side findings

The managerial variables consist of motivation factors and interfering factors.

### 4.3.1 Motivation factors

#### Frequency table

Variable	Number	Variable	Number
No focus on cost reductions	10	No focus on process innovation	4
Medium focus on cost reductions	5	Medium focus on process innovation	10
Focus on cost reductions	3	Focus on process innovation	4
No focus on quality	12	No focus on product innovation	4
Medium focus on quality	2	Medium focus on product innovation	10
Focus on quality	4	Focus on product innovation	4
No focus on resource location	7		
Medium focus on resource location	9		
Focus on resource location	2		

Table 10: Frequency table motivation factors

#### Management and control findings

Considering Figure 22, organizations with no focus on the motivation factors or an average focus on them, have less control over production compared with organizations that do focus on the motivation factors. Only organizations that focus on resource location have less control over the production process. Organizations that focus on cost reductions and delivering quality, produce more often in ownership.

Organizations that have a focus on process and product innovation, or have an average focus on them, produce more in ownership compared with organizations that have no focus on product innovation and process innovation (Figure 21).

Organizations that focus on cost reductions, quality and resource location outsource less often, compared with organizations that do not focus or have an average focus on those factors (Figure 20).

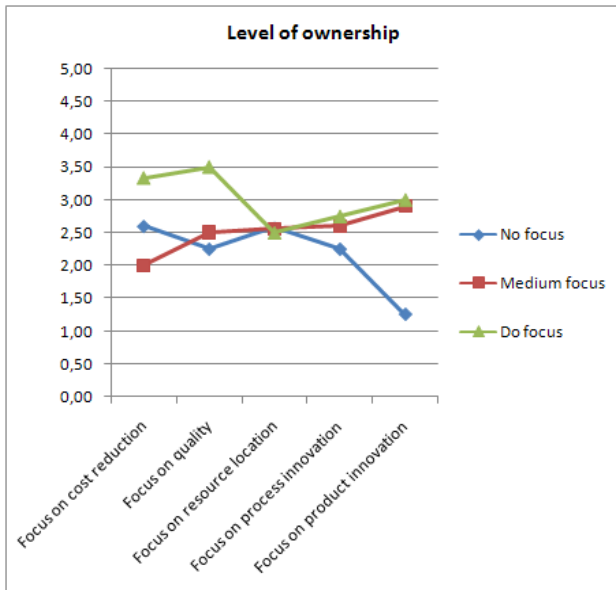


Figure 21: Influence motivation factors on level of ownership

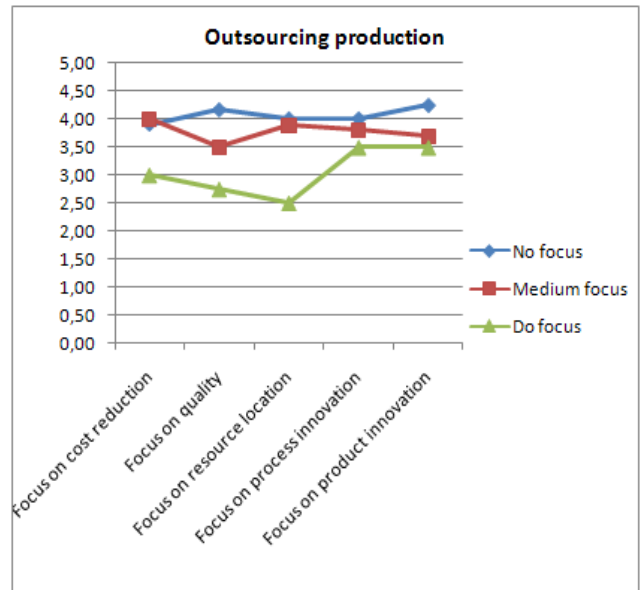


Figure 20: Influence motivation factors on level of outsourcing

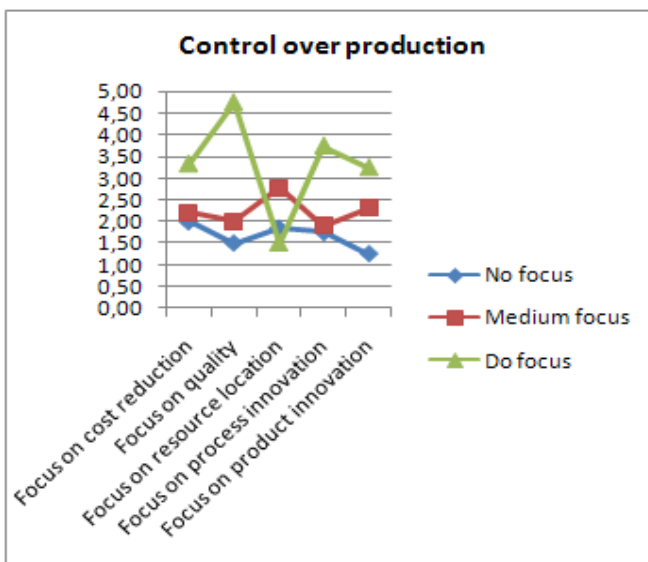


Figure 22: Influence motivation factors on level of control

### Location findings

As for the influence of the motivation factors on the variable concerning location (Figure 23), only the outstanding variables are discussed. Organizations that focus on cost reductions all produce nationally, compared with organizations that do not focus on cost reductions. Organizations that do not focus on cost reductions all produce internationally. This same effect occurs for organizations that do or do not focus on quality, and organizations that do or do not focus on process innovation. Organizations that do focus on product innovation produce more often nationally and internationally.

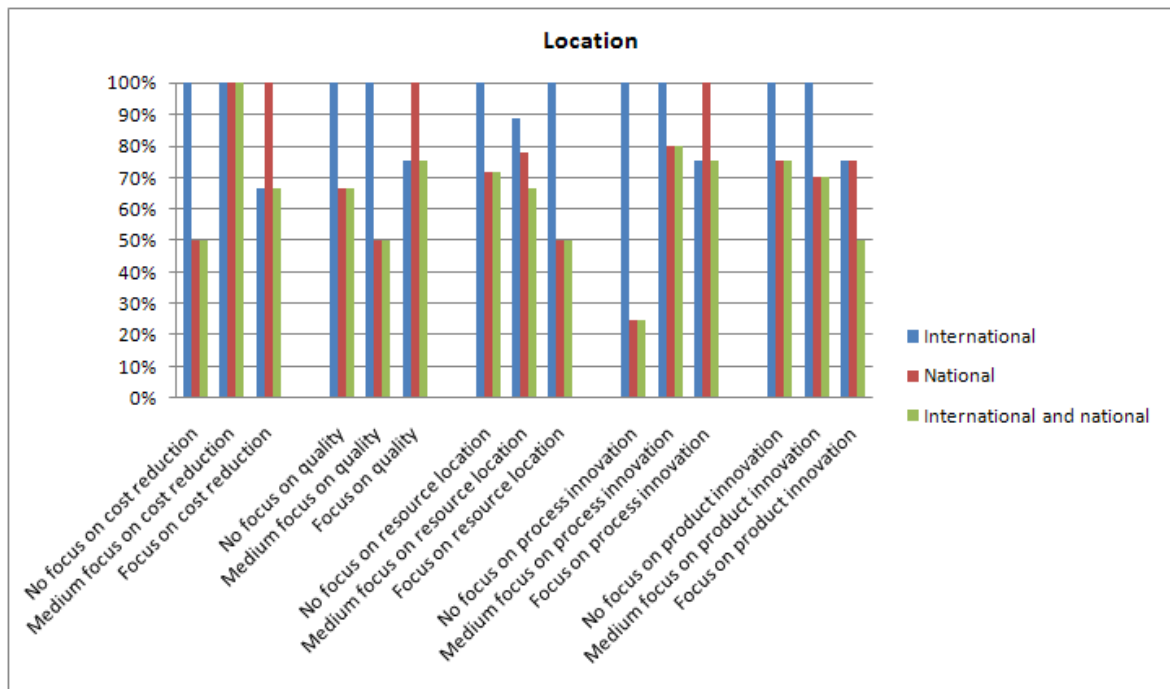


Figure 23: Influence motivation factors on location variable

### Proposition discussion

3. Compared with organizations that do not focus on motivation factors, organizations with a higher focus on motivation factors

a: outsource production more often

b: **keep control over the production**

4. Compared with organizations that do not focus on cost reductions, organizations with a higher focus on cost reductions outsource more often to **international locations**

Organizations with a high focus on motivation factors are less concerned with outsourcing than organizations with no focus on motivation factors or with an average focus on these factors. Organizations with a focus on cost reductions and quality outsource less often and produce more often in ownership. Organizations with no focus on motivation factors outsource more often than organizations with a focus on motivation factors, therefore, proposition **3a** is rejected.

Proposition **3b** is accepted for all motivation factors, except resource location. Organizations with a focus on cost reductions, quality, process innovation and product innovation keep more control over the production process than organizations with no focus on these motivation factors.

Proposition **4** is rejected. Organizations with a focus on cost reductions produce more nationally, instead of internationally.

### 4.3.2 Interfering factors

#### Frequency table

Variable	Number	Variable	Number
No focus on CSR	8	Expect no culture difference	7
Medium focus on CSR	7	Expect a small culture difference	9
Focus on CSR	3	Expect a culture difference	2
No focus on employee policy	8	Expect no communication barrier	9
Medium focus on employee policy	6	Expect a small communication barrier	6
Focus on employee policy	4	Expect a communication barrier	3

Table 11: Frequency table interfering factors

#### Management and control findings

Organizations that do not focus on the interfering factors produce less often in ownership. Organizations that focus on CSR, and organizations with no or an average focus on the interfering factors produce more often in ownership. Furthermore, organizations that expect a communication barrier also produce more often in ownership (Figure 24). Organizations that expect a culture difference produce less often in ownership compared with organizations that expect no culture difference. Considering the level of outsourcing (Figure 25), organizations that do not focus on the interfering factors have a higher rating for outsourcing for all variables. Organizations that expect a communication barrier have a very low rating for outsourcing production. Organizations that focus on employee policy and organizations with an average focus on employee policy have a lower rating for outsourcing, compared with organizations that do not focus on employee policy. Organizations with a focus on CSR, employee policy, and organizations with an average focus on these factors, have more control over the production. Furthermore, organizations that expect a communication barrier have more control over the production, compared with organizations that do not focus on these interfering factors (Figure 26).

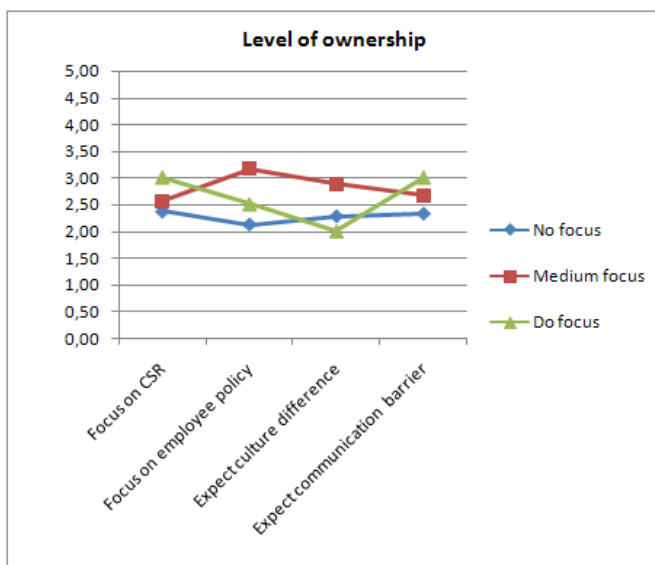


Figure 24: Influence interfering factors on level of ownership

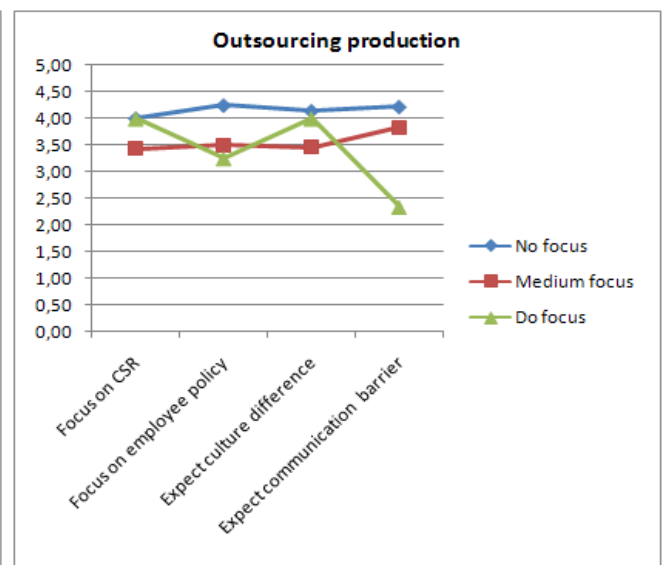


Figure 25: Influence interfering factors on level of outsourcing

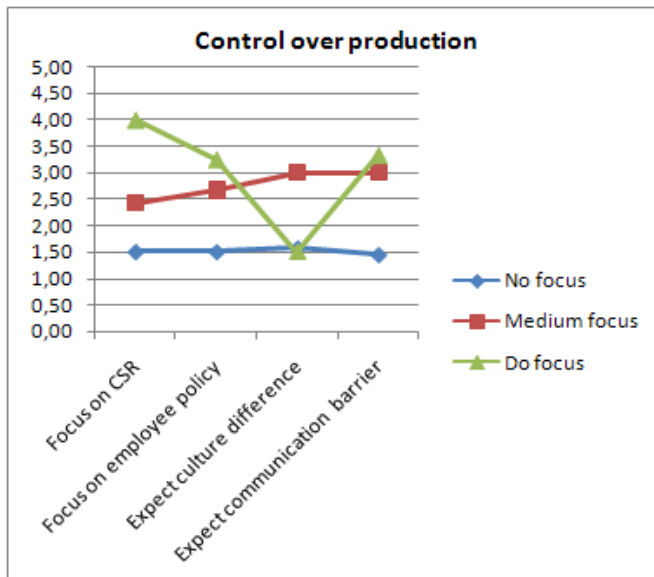


Figure 26: Influence interfering factors on level of control

### Location findings

Considering Figure 27, organizations that focus on CSR, employee policy and organizations that expect a communication barrier outsource products less often to international locations, compared with organizations that do not focus on these interfering factors or have an average focus on them. Organizations that do not expect a culture difference outsource more often to international locations, instead of national locations.

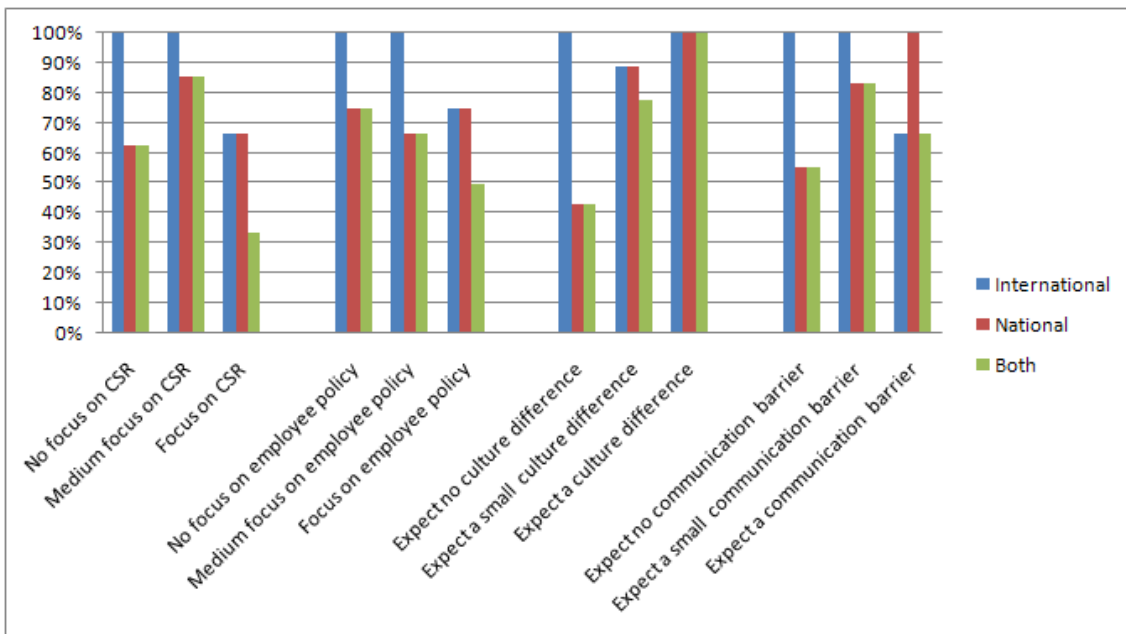


Figure 27: Influence interfering factors on location variable

### Proposition discussion

5. Compared with organizations that do not focus on interfering factors, organizations with a higher focus on interfering factors

a: produce more often in **ownership**

b: **keep control over** the production

**6. Organizations that expect a culture barrier and a communication barrier produce more often on national locations**

Organizations with an average focus, and organizations that focus on CSR and employee policy produce more often in ownership. Also organizations that expect a communication barrier produce more often in ownership, compared with organizations with no focus on these interfering factors. For these interfering factors, proposition **5a** is accepted. Proposition **5a** is rejected for organizations that expect a culture difference, these organizations produce less often in ownership.

Organizations that focus on CSR, employee policy and organizations that expect a communication barrier have more control over the production. For these interfering factors proposition **5b** is accepted. Organizations that expect a culture difference have less control over the production. For this variable, proposition **5b** is rejected.

Organizations that expect a communication barrier and a culture barrier do produce more often nationally, in contrast to organizations that do not expect a culture barrier or communication barrier. Therefore, proposition **6** is accepted.

#### 4.4 Physical, hard side findings

The physical findings consist of production size, automation level production process, process knowledge, customer specific and demand fluctuation.

##### 4.4.1 Production size

###### Frequency table

Variable	Number	Variable	Number
Small production volume < 100	4	Small size of production batches	6
Medium production volume 100-10.000	3	Medium size of production batches	4
Large production volume > 10.000	12	Large size of production batches	8
Small level repetitiveness units of production	9		
Medium level repetitiveness units of production	6		
Large level repetitiveness units of production	3		

Table 12: Frequency table production size

###### Management and control findings

Medium-sized and large production volumes have a lower rating for producing in ownership, compared with small production volumes. Production units with a small level of repetitiveness are less produced in ownership, compared with production units with an medium level of repetitiveness and production units with a large repetitiveness of units. Large production batches are also more produced in ownership, compared with smaller size production batches (Figure 29).

Production units with a small level of repetitiveness and small size production batches are more outsourced than production units with a large level of repetitiveness and larger size production batches. The production volume does not influence the level of outsourcing (Figure 28).

Production units with a large level of repetitiveness and large size production batches are produced with a high level of control over the production, compared with production units with a small level of repetitiveness and small size production batches (Figure 30).

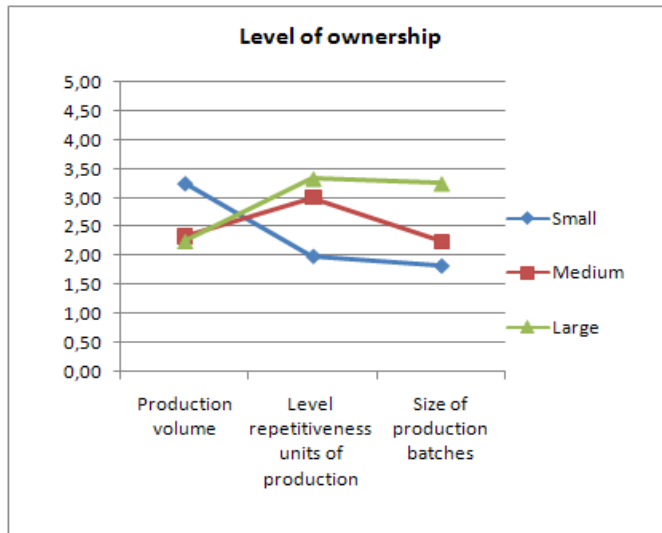


Figure 29: Influence production size on level of ownership

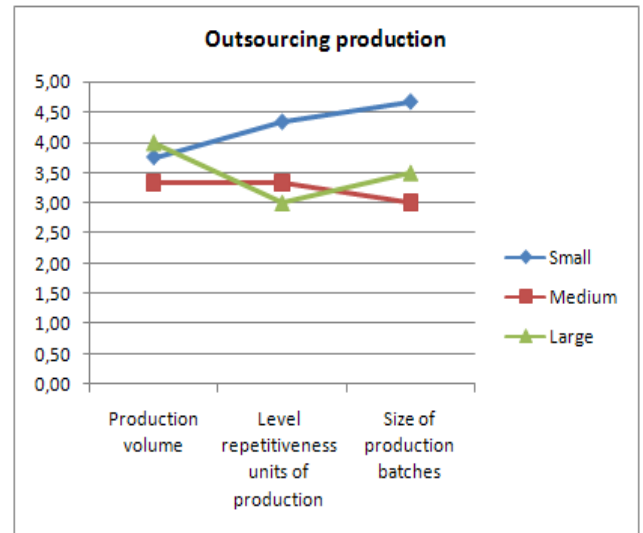


Figure 28: Influence production size on level of outsourcing

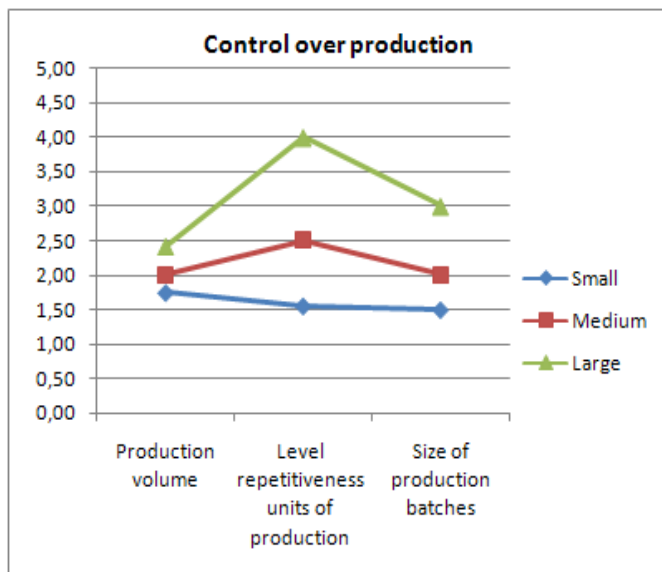


Figure 30: Influence production size on level of control

### Location findings

The production of large annual production volumes (> 10.000 pieces) and production units with a high level of repetitiveness are located nationally as well as internationally. The number of organizations that produce nationally is almost equal with the number of organizations that produce internationally. Organizations with small and medium-sized annual production volumes and production units with a small level of repetitiveness, have more production located internationally than nationally. The difference of small and large production batches does not influence the variable concerning location much.



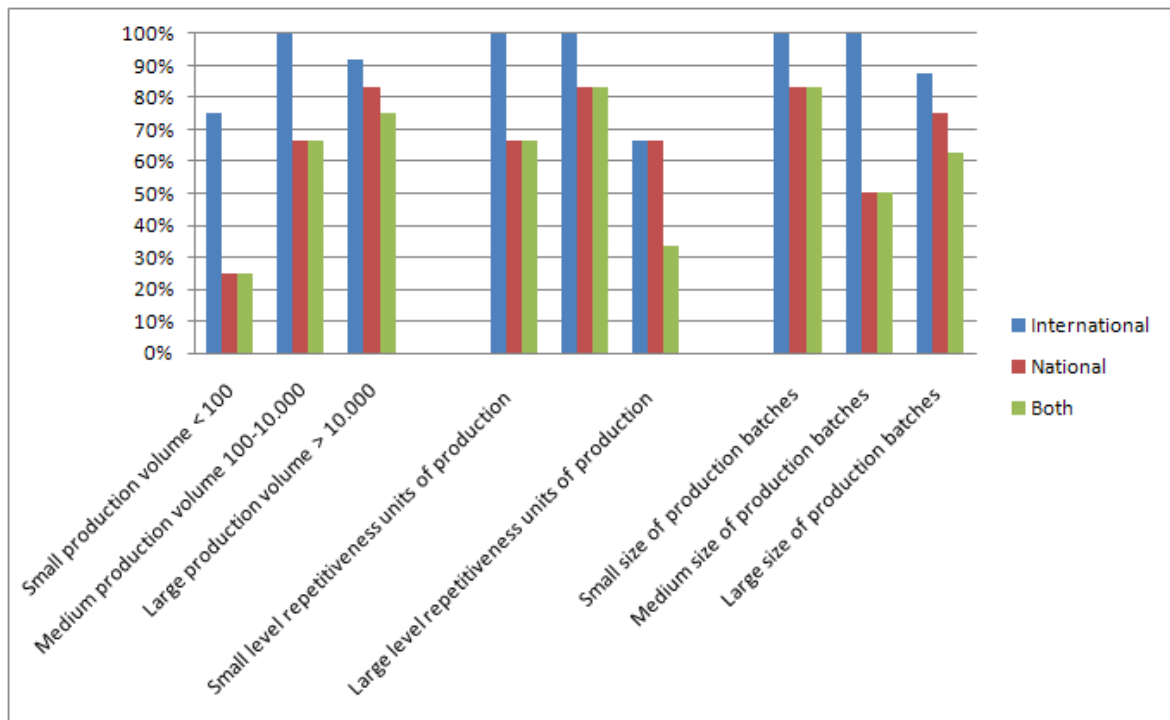


Figure 31: Influence production size characteristics on location variable

### Proposition discussion

7. Compared with organizations with a small production size (small annual volume, non-repetitive, small batches), organizations with a larger production size

a: **outsource** production more often

b: outsource more often to **international locations**

Small production volumes, production units with a high level of repetitiveness and large production batches are more frequently produced in ownership. Production units with a small level of repetitiveness and small size production batches are more outsourced. Therefore, proposition **7a** is rejected for the level of repetitiveness and for the variable large production batches. Regarding production volume, small production volumes are more produced in ownership. Considering Figure 28, the rating for outsourcing is equal for all annual production volumes, therefore, no assumption is made about proposition **7a** for the variable production volume.

Proposition **7b** is also rejected. Large production volumes, production units with a high level of repetitiveness and large size of production batches are produced internationally and nationally in contrast to small production volumes, production units with a small level of repetitiveness and small production batches.

## 4.4.2 Automation level production process

### Frequency table

Variable	Number	Variable	Number
Low level of automation	6	Low level automatic assembly	4
Medium level of automation	6	Medium level automatic assembly	2
High level of automation	6	High level automatic assembly	12
Low level manual assembly	12		
Medium level manual assembly	1		
High level manual assembly	5		

Table 13: Frequency table automation level

Due to the single response on medium level manual assembly, this finding has been omitted from the analysis.

### Management and control findings

Considering Figure 32, production processes with a high level of automation are kept in ownership. Production processes with a low level of automatic assembly are also kept in ownership. Production processes with a high level of manual assembly, are more often outsourced (Figure 33). Production processes with a high level of automation and production processes with a low level of automatic assembly have a higher rating for control over production.

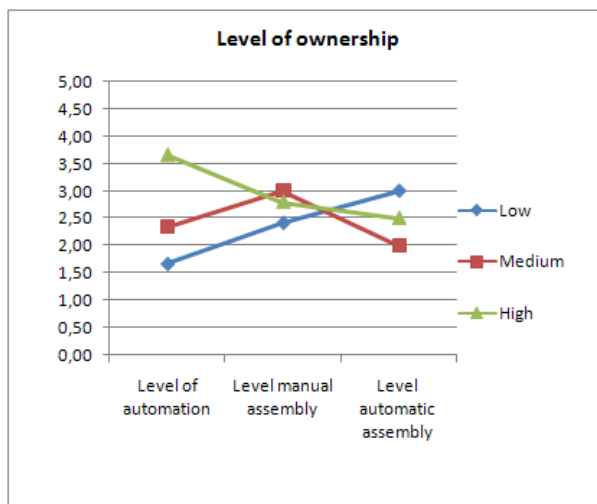


Figure 32: Influence automation level on level of ownership

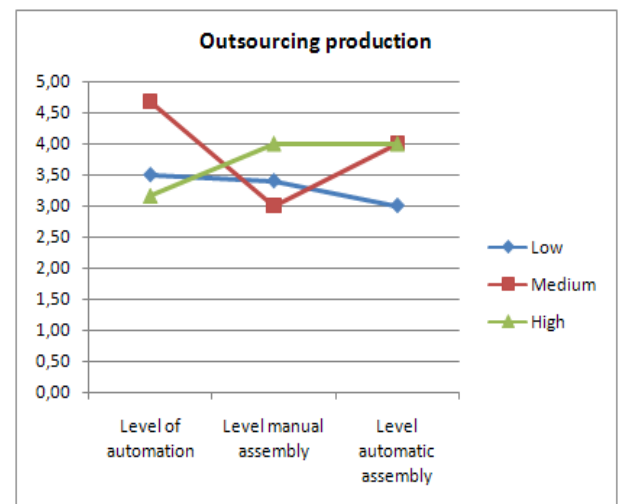


Figure 33: Influence automation level on level of outsourcing

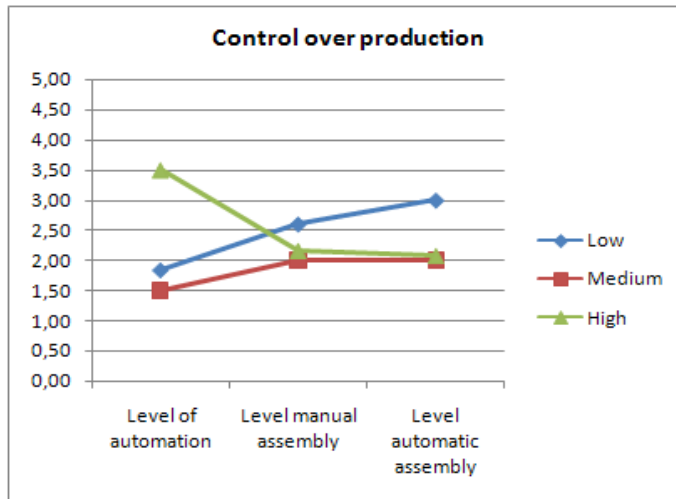


Figure 34: Influence automation level on level of control

### Location findings

Automation variables that are rated as medium, have a high rating for producing internationally. A high level of automation, a high level of manual assembly and a low level of automatic assembly are located nationally and internationally.

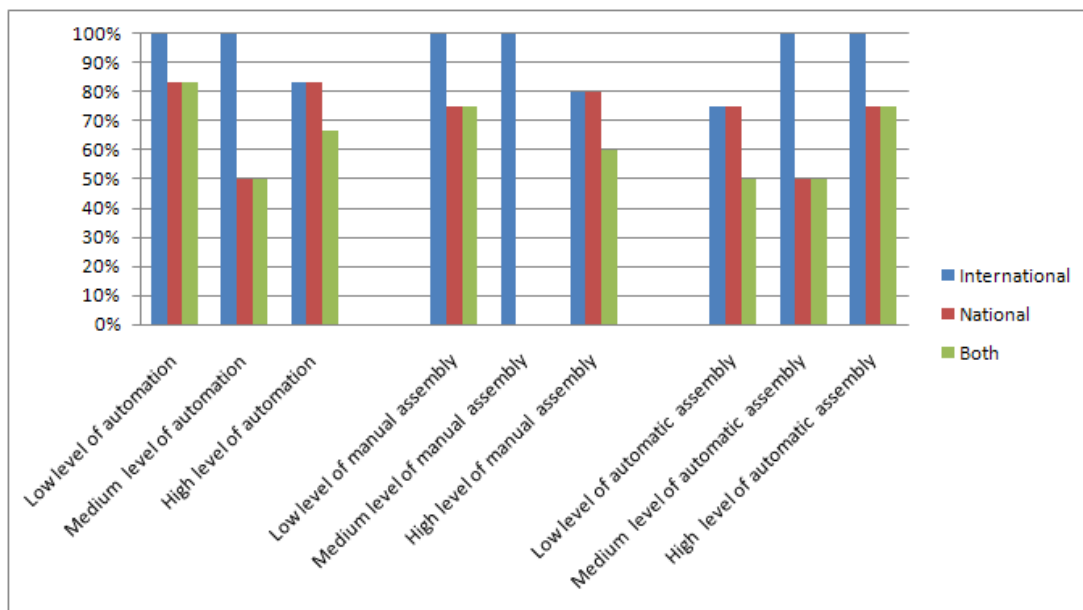


Figure 35: Influence automation level on location variables

### Proposition discussion

8. Compared with organizations that have a low automated production process, organizations with a higher level of automation

a: produce more often in **ownership**

b: **keep control over** the production

Considering the level of automation, a high level of automation is indeed kept in ownership, which means accepting proposition **8a** for level of automation.

Regarding the level of automatic assembly, highly automated assembly processes have a higher rating for outsourcing compared with low automated assembly processes. Furthermore, production processes that require a high level of manual assembly have also a higher rating for outsourcing and a lower rating for production in ownership, compared with production processes with a low level of manual assembly. Therefore, proposition **8a** is accepted for the level of manual assembly, but rejected for the level of automatic assembly

Organizations with a high automated production process have more control over the production than organizations with a less automated production process. Proposition **8b** is accepted for the automation of production. Organizations with a low level of automatic assembly have more control over the production process, compared with organizations with a high level of automatic assembly. As Figure 34 shows, the level of manual assembly has a very small influence on the control variable, but it could be concluded that organizations with a production process with a low level of manual assembly have more control than organizations with a production process with a high level of manual assembly. Therefore, proposition **8b** is also accepted for the variable concerning automatic assembly.

### 4.4.3 Process knowledge

#### Frequency table

Variable	Number	Variable	Number
Low complexity production process	7	Low education level process controller	9
Medium complexity production process	6	Medium education level process controller	8
High complexity production process	5	<del>High education level process controller</del>	<del>1</del>
High education level operator	5		
Medium education level operator	2		
Low education level operator	11		

Table 14: Frequency table process knowledge

Only one respondent has a production process that requires a high education level process controller. For this reason, this finding has been omitted from the analysis.

#### Management and control findings

Production processes with a high or average complex production process have a higher rating for production in ownership, compared with low complex production processes (Figure 37). A difference in education level of the operators has no clear influence on all management variables (Figure 38 and Figure 36). Low complex production processes have a slightly higher rating for outsourcing production, compared with high complex production processes (Figure 36).

Organizations with an average or high complex production processes have more control over the production process, compared with low complex production processes.

Production processes that require a low or average education level of process controllers are also implemented by the organization itself (Figure 38).

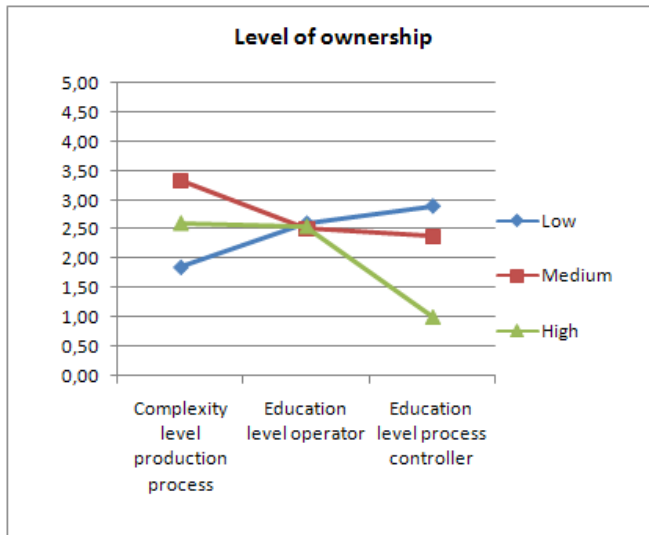


Figure 38: Influence knowledge intensity on level of ownership

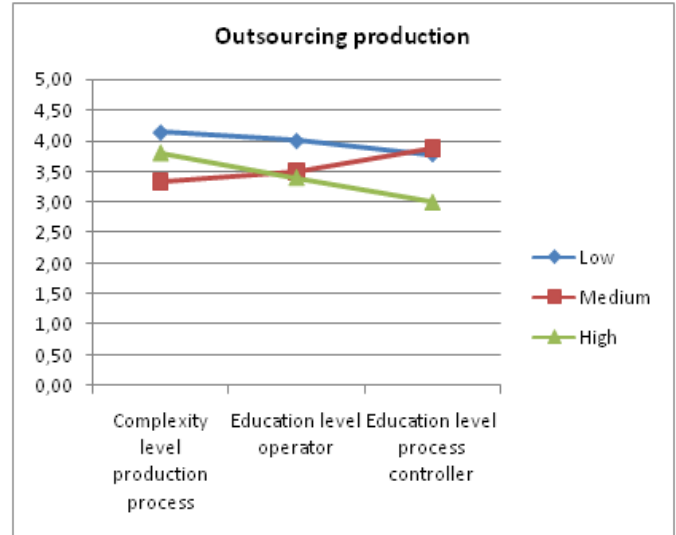


Figure 36: Influence knowledge intensity on level of outsourcing

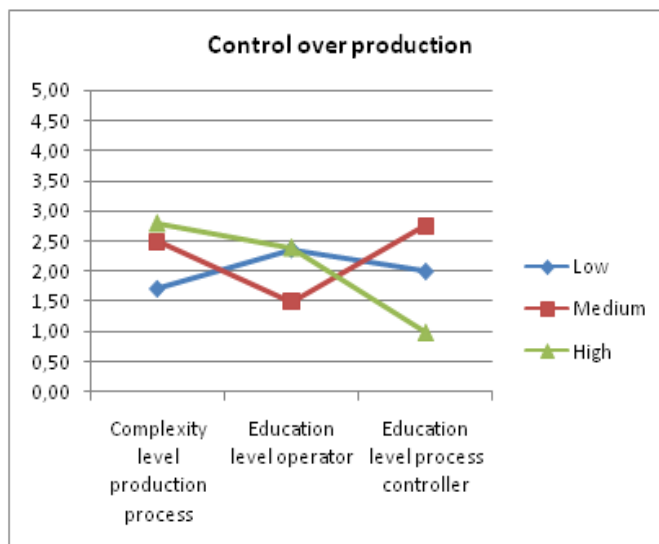


Figure 37: Influence knowledge intensity on level of control

### Location findings

Organizations with production processes that require a high education level of process controllers, have located their production nationally and internationally. Considering the complexity of production processes, a highly complex production process is more often located both nationally and internationally, compared with production processes with a low complexity.

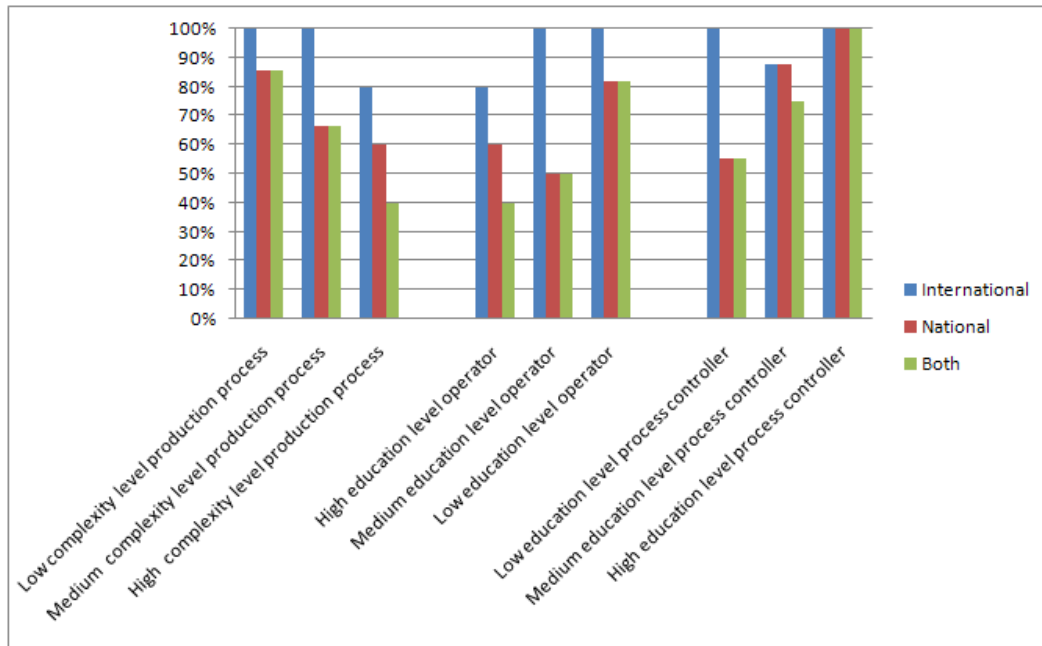


Figure 39: Influence process knowledge on location variable

### Proposition discussion

9. Compared with low knowledge intensive production processes (low complexity, low education level operators, low education level process controllers), highly knowledge intensive production processes

- a: produce more often **ownership**
- b: keep more **control** over the production

10. Low knowledge intensive production processes are more often located in **international** organizations.

Highly and medium complex production processes are often kept in ownership, and are less often outsourced. Therefore, proposition **9a** is accepted for the variable concerning complexity of the production process. The ratings for the education level of operators is almost equal and therefore no assumptions could be made regarding proposition **9a**.

As mentioned above, high and medium complex production processes are more kept in control than production processes with a low complexity. Regarding the different education levels of operators, production processes which require a high education level are kept under less control. Therefore, proposition **9b** is accepted for process complexity, and rejected for education level of operators and process controllers.

Production processes with a low and medium complexity level, and production processes that require a low or average education level of operators have a higher rating for international locations. Therefore, proposition **10** is accepted.

## 4.4.4 Customization

### Frequency table

Variable	Number	Variable	Number
Not tailor-made	11	Not keeping buffers	6
Medium tailor-made	2	Medium keeping buffers	3
Tailor-made	5	Keeping buffers	9

Table 15: Frequency table customization

### Management and control findings

Organizations that produce tailor-made products keep the production in ownership. Organizations that keep a buffer of the product have also a higher rating for production in ownership (Figure 41). Tailor-made products are produced in ownership and also outsourced. Organizations that keep no buffers or some buffers have a higher rating for outsourcing, compared with organizations that do keep buffers (Figure 40).

Organizations that produce tailor-made products, and organizations that keep buffers, have a higher rating for control over production, compared with organizations that produce non-tailor-made products, and organizations that keep no buffers.

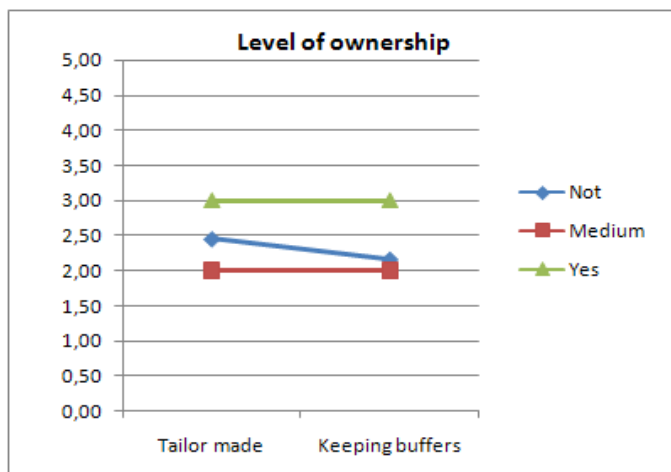


Figure 41: Influence customer specific on level of ownership

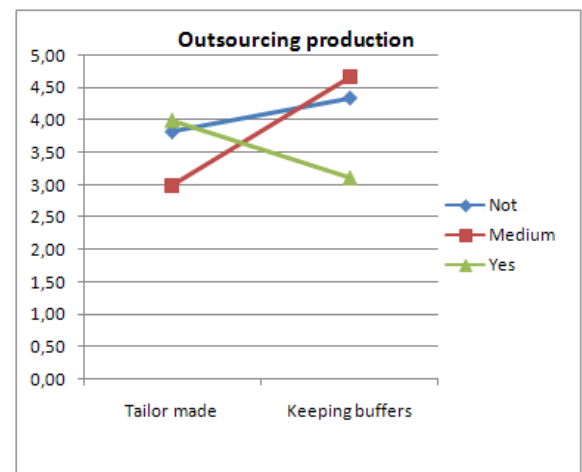


Figure 40: Influence customer specific on level of outsourcing

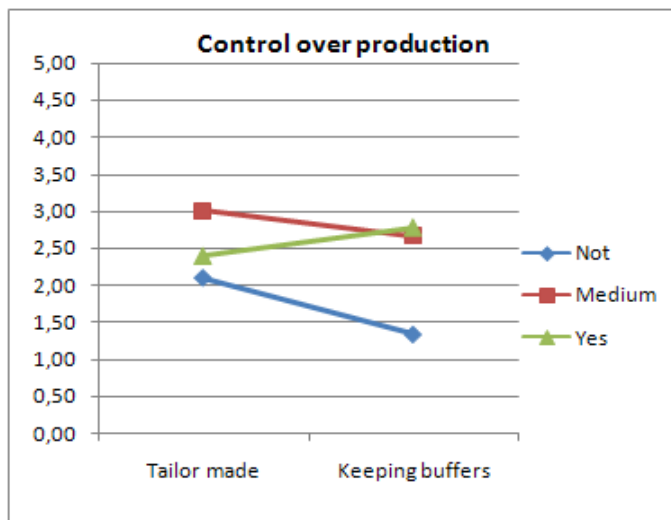


Figure 42: Influence customer specific on level of control

## Location findings

All organizations that do not produce tailor-made products have located their production internationally. Also organizations that keep no buffers or a number of buffers have located their production internationally. Organizations that keep buffers have located their production internationally and nationally.

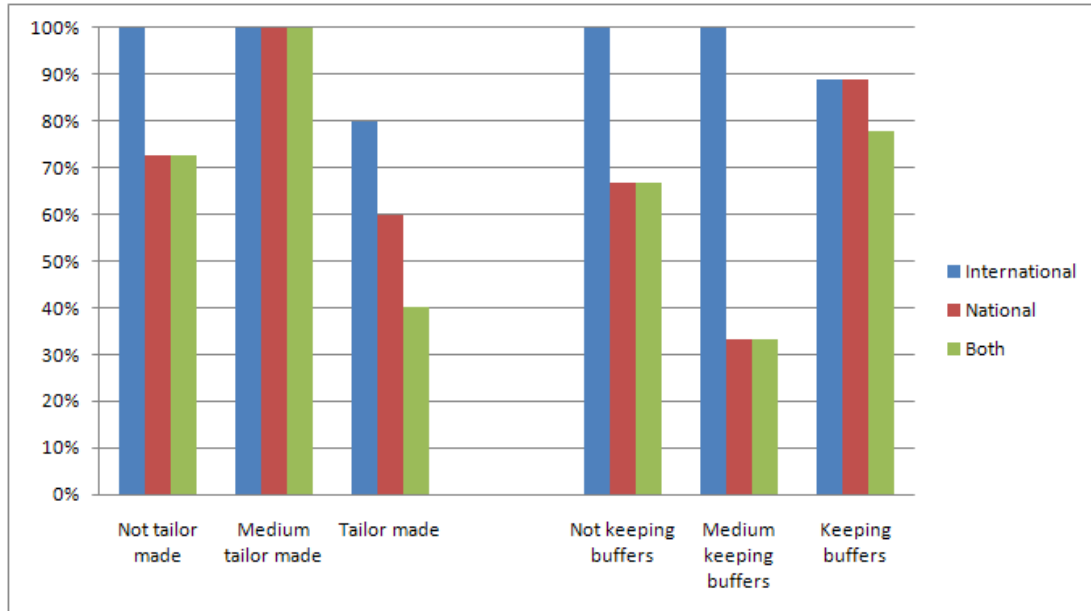


Figure 43: Influence customization on location variable

## Proposition discussion

11. Compared with organizations that produce non-tailor-made products, and organizations that keep buffers, organizations that produce tailor-made products and keep no buffers have

a: more production in **ownership**

b: more **control** over the production process

c: more production in **national** locations

Tailor-made products are more produced in ownership, which means accepting proposition **11a** for the level of tailor-made. However, tailor-made products and non-tailor-made products have the same rating for outsourcing.

Furthermore, tailor-made products are more often produced controlled by the organization itself, which accepts proposition **11b** for the level of tailor-made products. Organizations that keep no buffers have less control over the production and outsource production more often. Therefore, propositions **11a** and **11b** are rejected for the variable concerning keeping buffers.

Considering the influence on the location variable, by the level of tailor-made products, it is hard to draw a conclusion, because organizations that produce tailor-made products produce less often internationally and produce less often nationally compared with organizations that produce non-tailor-made products. Therefore, no assumptions could be made regarding proposition **7c**.

Considering the influence of the variable keeping buffers, organizations that keep buffers produce more often internationally as well as nationally. Therefore, proposition **7c** is rejected for the variable keeping buffers.



### 4.4.5 Demand fluctuation

Frequency table

Variable	Number	Variable	Number
Not dynamic demand	5	No sensitivity to market economy	8
Small dynamic demand	5	Average sensitivity to market economy	5
Dynamic demand	8	High sensitivity to market economy	5

Table 16: Frequency table demand fluctuation

#### Management and control findings

Products with a dynamic demand or a small dynamic demand, are more often produced in ownership than products with no dynamic demand. Products with little sensitivity to market economy and products with an average sensitivity to market economy are also more often produced in ownership compared with products which are highly sensitive to market economy and products with no sensitivity at all (Figure 44).

Products with no dynamic demand or a small dynamic demand have a higher rating for outsourcing than products with a dynamic demand. Products with little sensitivity to market economy have a lower rating for outsourcing compared with products with a sensitivity to market economy and with products with no sensitivity at all (Figure 45).

Organizations that produce products with a high dynamic keep more control over the production than organizations that produce products with a lower dynamic demand. Considering the influence of the sensitivity of products to market economy, it can be concluded that products with little sensitivity to market economy are produced under control of the organization (Figure 46).

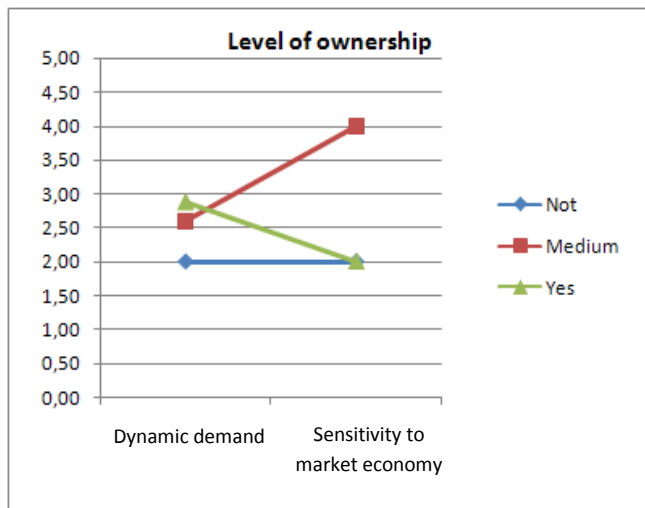


Figure 44: Influence demand fluctuating on level of ownership

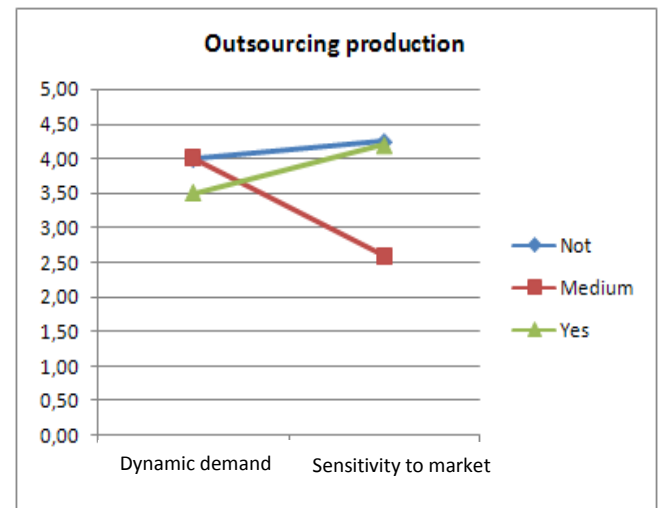


Figure 45: Influence demand fluctuating on level of outsourcing

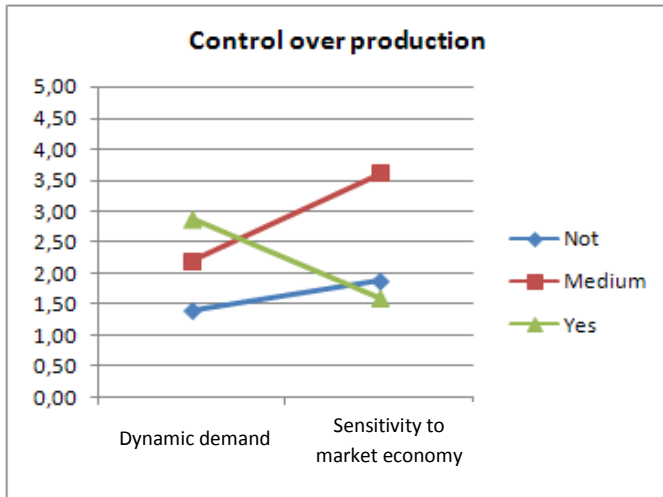


Figure 46: Influence demand fluctuating on level of control

### Location findings

All organizations that produce products with a low and high dynamic demand have their production located internationally. Products with a dynamic demand are more produced nationally compared with no dynamic demand. All organizations with products which are highly sensitive to market economy produce nationally and internationally. Products with no sensitivity to market economy produce nationally and internationally. Products with no sensitivity to market economy are more produced internationally, instead of nationally.

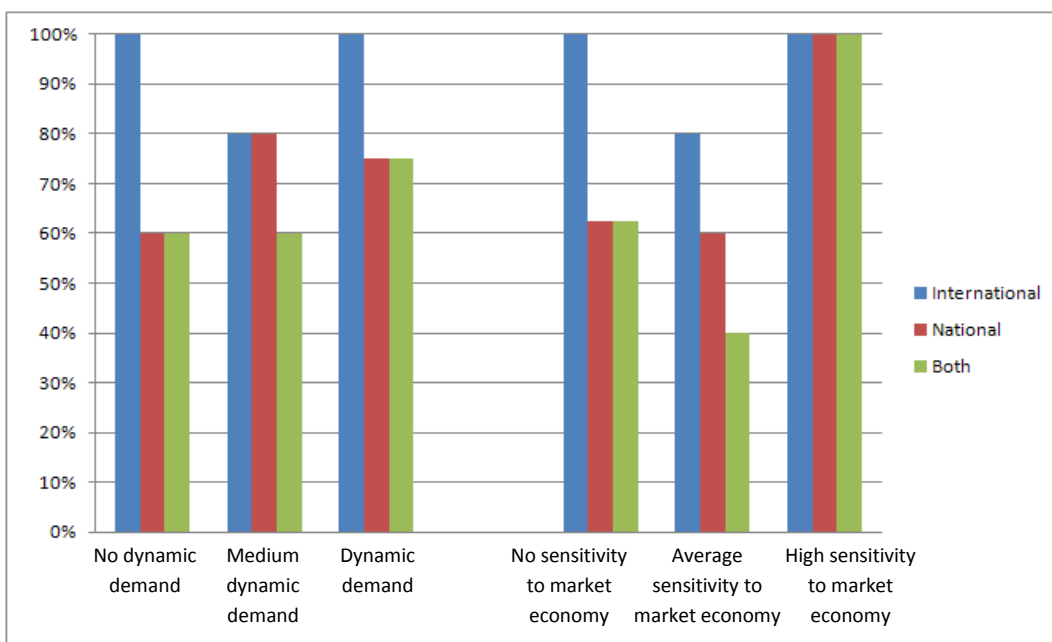


Figure 47: Influence demand fluctuation on location variable

### Proposition

12. Compared with organizations that produce products with a low fluctuation of demand, organizations that produce products with a high fluctuation of demand

- a: produce more often in **ownership**
- b: keep more **control** over the production
- c: produce more often in **national** locations

A difference in sensitivity to market economy has no influence on the rating of producing in ownership and outsourcing production. Therefore, proposition **12a** is rejected for the variable concerning sensitivity to market economy. Products with a high dynamic demand have a higher rating for producing in ownership compared with products with a low dynamic demand. Therefore, proposition **12a** is accepted for the dynamic demand. However, apart from producing in ownership, products with a high dynamic demand are also outsourced.

Products with a dynamic demand are indeed produced in control of the organizations. Therefore, proposition **12b** is accepted for the variable concerning dynamic demand. The level of sensitivity to market economy of a product has no clear different influence on the variable concerning control of production. Therefore, no assumptions could be made regarding the relation between sensitivity to market economy and the level of control over the production.

Products with a higher sensitivity to market economy are produced nationally and internationally. Products with a dynamic demand are slightly more often located nationally compared with products with a low dynamic demand. Therefore, proposition **12c** is accepted for the variable concerning dynamic demand but is rejected for the variable concerning sensitivity to market economy.

## 5 Conclusions

This chapter aims at presenting the relation between production systems and outsourcing strategies on an abstract level. The aim of this chapter is to present an answer to the central question. The central question formulated at the beginning of this research was:

**‘What is the relationship between outsourcing strategies and production systems?’**

In order to find an answer to the central question, the following research questions were formulated:

1. What are the characteristics of production systems?
2. What are the characteristics of outsourcing strategies?
3. How are characteristics of production systems and outsourcing strategies related?
4. Which production system characteristics have the largest influence on outsourcing strategies?

Research questions 1 and 2 will be discussed in section 5.1, research question 3 in section 5.2 and research question 4 in section 5.3. The central question will be answered in section 5.4.

### 5.1 Production systems and outsourcing strategies characteristics

#### Research question 1: What are the characteristics of production systems?

The characteristics of production systems are used as independent variables. Based on the literature, the generic production systems have been divided into the following main elements:

- Organizational characteristics
- Managerial, soft side characteristics
- Physical, hard side characteristics

#### Research question 2: What are the characteristics of outsourcing strategies?

The outsourcing strategy characteristics are used as the dependent variables. The generic outsourcing strategies have been divided into the following variables:

- Management (ownership)
- Control
- Location

The variable concerning management is defined by the level of ownership over the production. The variable concerning control is defined by the level of control over the production, and the variable concerning location indicates whether the production is located nationally or internationally.

## 5.2 Relation between production systems and outsourcing strategies

### Research question 3: How are characteristics of production systems and outsourcing strategies related?

The findings of the propositions will be presented in tables. The relation between production systems and outsourcing strategies, and the associated propositions will be discussed per group of independent variables:

5.2.1: Organizational characteristics

5.2.2: Managerial, soft side characteristics

5.2.3: Physical, hard side characteristics

Outstanding findings will be outlined and explanations are discussed.

### 5.2.1 Relation organizational characteristics and outsourcing strategies

This section describes the relation between organizational characteristics and the variables concerning outsourcing strategy.

<i>Organizational characteristics</i>	Ownership	Accepted or rejected	Control over production	Accepted or rejected	Location	Accepted or rejected
Organization size						
Large turnover	More ownership	R	More control	A	More internationally	A
Larger number of employees	More ownership	R	More control	A	More internationally	A
Market location						
Market focus	-	-	-	-	Equal with location	A

Table 17: Overview organizational characteristics propositions

#### Organization size

Considering the findings of the organizational characteristics, one can conclude that large organizations do have more control over the production, and produce more often internationally. However, a remarkable outcome was that small organizations (turnover < 10 million and < 100 employees) and large organizations (turnover > 50 million and > 250 employees) produced less in ownership and outsourced more compared with medium-sized organizations (turnover 10-50 million and 100-250 employees). This suggests that small organizations need to outsource, because these organizations have fewer resources (e.g. capital and human resources) to fulfill the production in ownership. Because they outsource completely, they do not keep control of the production. The level of control is the difference between the small and large organizations.

Large organizations have the resources to outsource production when it is more profitable. Although large organizations outsource, they have the resources to keep control over the outsourced production. Furthermore, the higher level of resources could also reinforce the proposition that large organizations produce more often internationally.

Medium-sized organizations have probably just enough resources to produce in ownership and do not necessarily need to outsource.

## Market focus

As the data show, the market focus is equal with the location of production. However, one remark needs to be made. Due to the fact that there was only one respondent with a national market focus, the national market focus was omitted from the analysis. Furthermore, although a relation was established, the relation between market focus and production location was not very solid, which means that no strong conclusion could be drawn.

## 5.2.2 Relation managerial characteristics and outsourcing strategies

<i>Managerial characteristics</i>	Ownership	Accepted or rejected	Control over production	Accepted or rejected	Location	Accepted or rejected
Motivation factors						
High focus cost reductions	More outsourcing	R	More control	A	More internationally	R
High focus quality	More outsourcing	R	More control	A		
High focus resource location	More outsourcing	R	More control	R		
High focus process innovation	More outsourcing	R	More control	A		
High focus product innovation	More outsourcing	R	More control	A		
Interfering factors						
High focus CSR	More ownership	A	More control	A		
High focus employee policy	More ownership	A	More control	A		
Expect culture difference	More ownership	R	More control	R	More nationally	A
Expect communication barrier	More ownership	A	More control	A	More nationally	A

Table 18: Overview managerial characteristics propositions

### Motivation factors

The results as for the presumed motivation factors for outsourcing were striking. According to the data, the motivation factors turned out to be interfering factors for outsourcing the production. Organizations with a focus on cost reductions, quality, process innovation and product innovation produce more often in ownership and outsource less often. Although new knowledge is a resource for innovation, it seems that organizations do not collect this new knowledge through outsourcing. The findings on the variable concerning control indicate that organizations do keep control over the production process, when they have a focus on those strategy factors. Cost reductions, innovation and delivering quality can only be achieved when the organization keeps control over the production process. Especially organizations that focus on quality have a very high level of control. Regarding the variable concerning the location, organizations that focus on cost reductions produce more often nationally instead of internationally. Based on the data collected in this research, it seems that the trend of outsourcing for cost reductions (LCC) has ended.

### Interfering factors

Remarkable findings with regard to the interfering factors are that organizations that focus on CSR, employee policy and organizations that expect a communication barrier rely more often on production in ownership. Organizations that focus on employee policy, are less likely to outsource when dismissing employees is a result of this outsourcing.

Even in the present, organizations that expect a communication barrier, outsource less often, and produce more often in national locations. Although organizations with a focus on CSR are still outsourcing, they have a very high level of control. This corresponds with the assumption that focusing on CSR means keeping control over the production. Organizations that expect a communication barrier or a culture barrier produce more often nationally.

### 5.2.3 Relation physical characteristics and outsourcing strategies

<i>Physical characteristics</i>	Ownership	Accepted or rejected	Control over production	Accepted or rejected	Location	Accepted or rejected
Production size						
Large production batches	More outsourcing	R			More internationally	R
Production units with a high level of repetitiveness	More outsourcing	R			More internationally	R
Large annual volume	More outsourcing	-			More internationally	R
Automation level						
High level of automation	More ownership	A	More control	A		
High level of automatic assembly	More ownership	R	More control	R		
Low level of manual assembly	More ownership	A	More control	A		
Knowledge intensity						
High complexity	More ownership	A	More control	A		
High education level operators	More ownership	-	More control	R		
High education level process controllers	More ownership	-	More control	R		
Low knowledge intensity					More Internationally	A
Customization						
Tailor-made	More ownership	A	More control	A	More nationally	-
Not keeping buffers	More ownership	R	More control	R	More nationally	R
Demand fluctuation						
High dynamic demand	Ownership	A	More control	A	More nationally	A
Highly sensitive to market economy	Ownership	R	More control	-	More nationally	R

Table 19: Overview physical characteristics propositions

### Production size

It was assumed that larger production sizes, were more often outsourced due to the high level of standardization. Considering the data, the opposite occurs. Small production sizes are outsourced and large production sizes are produced in ownership.

When one compares these findings with the findings of the relation between managerial characteristics and outsourcing strategies, the following could be suggested. Organizations that focus on cost reductions, quality, product innovation and process innovation probably focus on improving their main production process for their main product. In other words, it seems that organizations keep large production volumes of their main product in ownership, and improve that production process on the factors: quality, cost reductions, process innovation and product innovation.

### Automation level

Considering the findings on the influence of automation level on outsourcing strategies, it could be observed that production processes with a low level of manual assembly and with a high level of automation are kept in ownership. Furthermore, the analysis shows that highly automated production processes are located nationally as well as internationally, compared with low automated production processes which are located internationally.

The observation that highly automated production processes are kept in ownership and located nationally, could be linked with the conclusion that organizations that focus on cost reductions are keeping production in ownership, because a highly automated production process requires fewer employees.

Furthermore, a highly automated production process could also refer to production processes that produce large annual production volumes, which explains the conclusion above that large production sizes are kept in ownership.

The level of automation of the assembly process does not influence the outsourcing strategy. On the contrary, whether or not assembly is involved in the production process influences the outsourcing strategy. Production processes that require a high level of assembly have a higher rating for outsourcing, compared with production processes that require a low level of assembly.

### Knowledge intensity

Due to the fact that there was only one single response for the variable concerning high education level of process controller, this variable was omitted. The other ratings of the variable concerning education level of process controller and the ratings of the variable concerning education level of operators were almost equal, therefore, no clear conclusions could be drawn with regard to these variables.

As the data show, highly complex production processes are kept in ownership of the organization. Organizations with highly complex production processes also have more control over the production. A high complexity of the production processes indicates a higher level of automation of the production processes. Referring to previous results, highly automated production processes are also kept in ownership and under control of the organization itself, which confirms the results. Production processes which require a low knowledge insensitivity have a higher rating for international locations.



### Customization

Organizations that keep buffers outsource less often, produce more in ownership, and have more control over the production compared with organizations that keep no buffers. No clear explanation could be found for this result.

Although it is a bit of a guess, the conclusions that highly automated, complex production processes and large, repetitive production batches are kept in ownership, could explain the keeping of buffers.

Tailor-made products are more often produced in ownership, compared with non-tailor-made products. In comparison, tailor-made products and non-tailor-made products have the same rating for outsourcing, which suggests that the production processes of tailor-made products are also outsourced.

### Demand fluctuation

High dynamic demands have a higher rating for production in ownership compared with products with no dynamic demand. Products with a low dynamic demand are more often outsourced. Like results have shown, organizations that produce products with a high dynamic demand, have a higher level of control over the production process. High dynamic production processes are also located in national locations. The findings for a high level of control could indicate a higher flexibility to react on demand fluctuation. As results have shown, products with an average sensitivity to market economy have a high rating for production in ownership and control over production, and a low rating for outsourcing production.

## 5.3 Strong influences of production system characteristics on outsourcing strategies

### Research question 4: Which production system characteristics have the largest influence on outsourcing strategies?

This section outlines strong influences of the independent variables on the dependent variables. The first three sections describe the relation between a combination of all variables and the dependent management and control variables. All independent variables are compared with the dependent management and control variables, which consisted of (referring to section 3.2.3):

- Level of management (ownership) section 5.3.1
- Level of outsourcing section 5.3.2
- Level of control section 5.3.3

Three figures are constructed based on one of the three dependent variables.

Section 5.3.4 describes strong relations between a combination of all independent variables and the dependent location variable. Notable results are emphasized.

### 5.3.1 Strong influence on level of ownership

For the dependent variable level of ownership, a figure is selected on the rating of the dependent variable 'level of ownership'. After this, a trend line is created on the 'level of ownership' ratings. The linear equation was:

	Linear equation	R <sup>2</sup>
<b>Ownership</b>	<b>Y= 0,0238X + 3,4226</b>	<b>0,9008</b>

Considering the high rating of R<sup>2</sup>, the reliability of the trend line is reasonable. The second step consisted of comparing the trend line with the actual figure line of the variable. Variables that differed more than 0,5 from the trend line are regarded as outliers of the trend line, which indicates a strong positive or negative influence on the level of ownership (see circles in Figure 48).

For the level of ownership, the outliers were:

	Difference rating and trend line
<b>Positive outlier</b>	
Products with an average sensitivity to market economy	0,6566
<b>Negative outliers</b>	
No focus on product innovation	-0,531
National market location	-0,7593
High education process controllers	-0,7376

Table 20: Strong relations production systems and level of ownership

The results show that products with an average sensitivity to market economy are definitely produced in ownership. Organizations with a national market focus and organizations with process controllers with a high education level were omitted from this research, because these findings were based on only one respondent.

Organizations with no focus on product innovation do not produce in ownership.

### 5.3.2 Strong influence on level of outsourcing production

For the dependent variable, level of outsourcing production, the same method is applied. As Figure 49 shows, only one outlier could be found.

	Linear equation	R <sup>2</sup>
<b>Level of outsourcing</b>	<b>Y = 0,0226X + 2,8501</b>	<b>0,9343</b>

	Difference rating and trend line
<b>Negative outlier</b>	
Expect a communication barrier	-0,562

Table 21: Strong relations production systems and level of outsourcing

Organizations that expect a communication barrier are definitely not outsourcing.

### 5.3.3 Strong influence on level of control over production

Also for the last dependent variable, level of control, a figure is constructed. As shown in Figure 50, 4 positive outliers could be found for the dependent variable level of control.

	Linear equation	R <sup>2</sup>
<b>Level of control</b>	<b>Y= -0,0342X + 3,5994</b>	<b>0,9277</b>

	Difference rating and trend line
<b>Positive outliers</b>	
Focus on quality	1,5455
High level of repetitive units of production	0,8431
Focus on CSR	0,8193
Focus on process innovation	0,6169

Table 22: Strong relations production systems and level of control

Organizations that focus on quality definitely keep the production in their control. Furthermore, organizations with a high level of repetitive units of production, organizations with a focus on CSR and organizations with a focus on process innovation also produce controlled by the organization itself.

### 5.3.4 Strong influence on location variable

In order to find strong relations between the independent variables and the variable considering location, the following method has been used. First, for every independent variable, the differences between located nationally, located internationally and located both internationally and nationally have been calculated. Differences between locations equal or larger than 50% are regarded as strong differences.

	International	National	Both	Differences national and international	Differences both and international	Differences both and national
Medium level manual assembly	100%	0%	0%	100%	0%	-100%
No focus on process innovation	100%	25%	25%	75%	0%	75%
Keeping some buffers	100%	33%	33%	67%	0%	67%
Expect no culture difference	100%	43%	43%	57%	0%	57%
Production volume <100	75%	25%	25%	50%	0%	50%
No focus on cost reduction	100%	50%	50%	50%	0%	50%
Medium focus on quality	100%	50%	50%	50%	0%	50%
Focus on resource location	100%	50%	50%	50%	0%	50%
Medium size of production batches	100%	50%	50%	50%	0%	50%
Medium level of automation	100%	50%	50%	50%	0%	50%
Medium level automatic assembly	100%	50%	50%	50%	0%	50%
Medium education level operator	100%	50%	50%	50%	0%	50%
Turnover 10-50 million	83%	50%	33%	33%	17%	50%

Table 23: Strong relations production systems and location variable

Figure 51 presents an overview of the influence of all independent variables on the dependent location variable. Figure 52 shows the differences between the influences, the variables that had an equal or larger difference than 50% have been circled.

The independent variables mentioned in the first column of Table 23, have a strong influence on the dependent location variable. Because there was only one respondent of 'medium level of manual assembly' this variable has been omitted. Like the result in the tables shows, organizations with no focus on process innovation all produce internationally, and only 25% also produces nationally. Also organizations that do not expect a culture difference more often produce internationally.

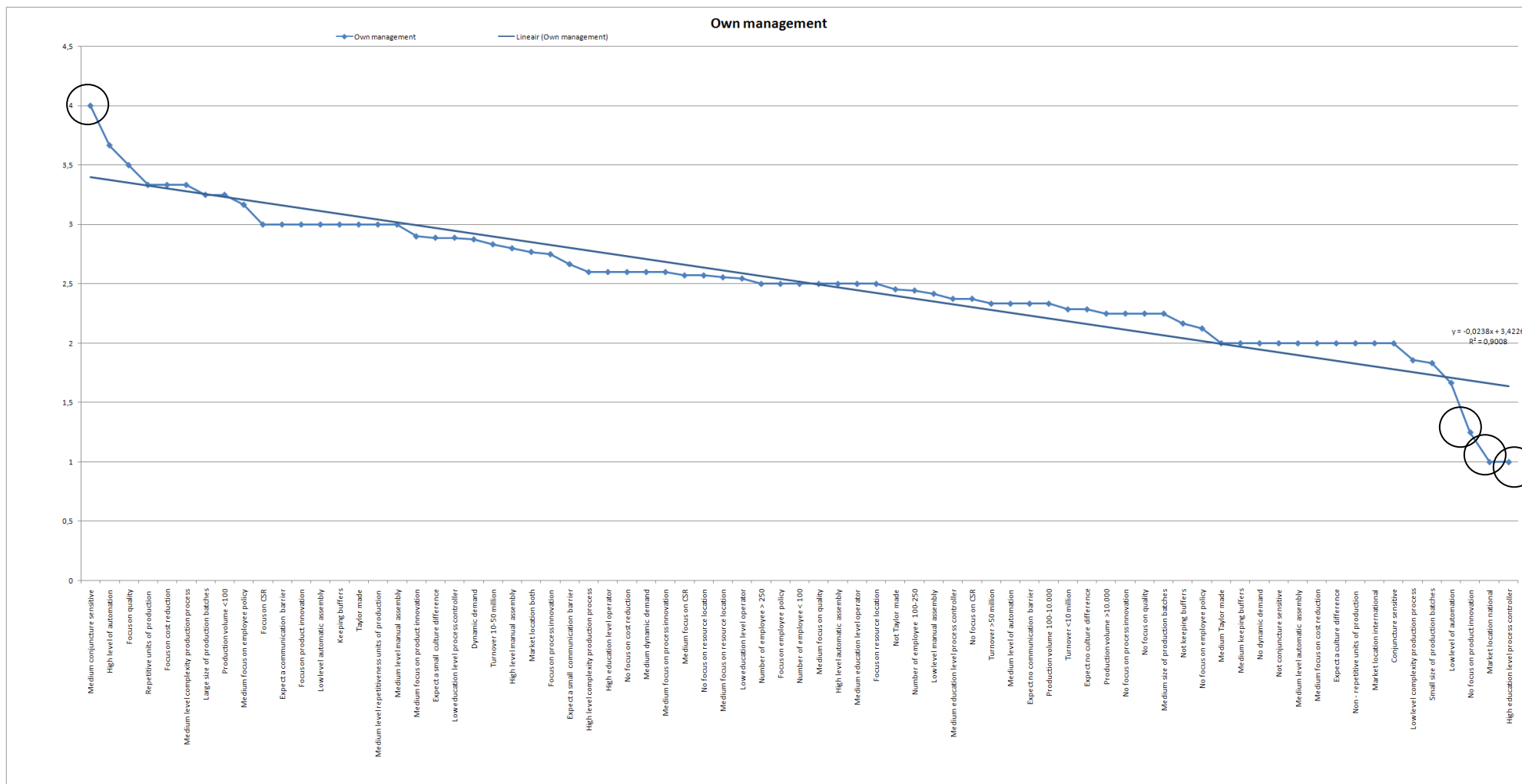


Figure 48: Strong relations for ownership variable

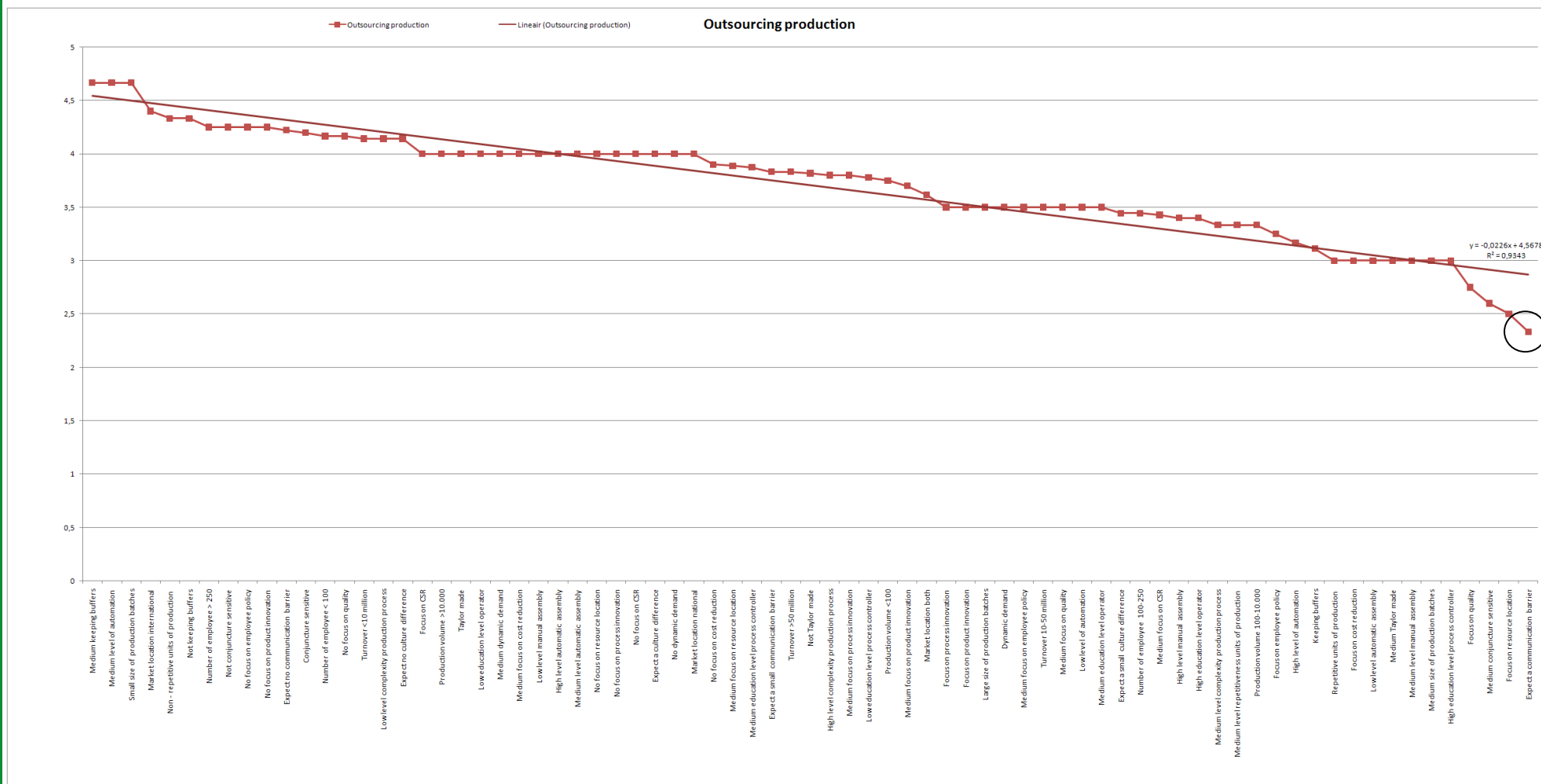


Figure 49: Strong relations for outsourcing production

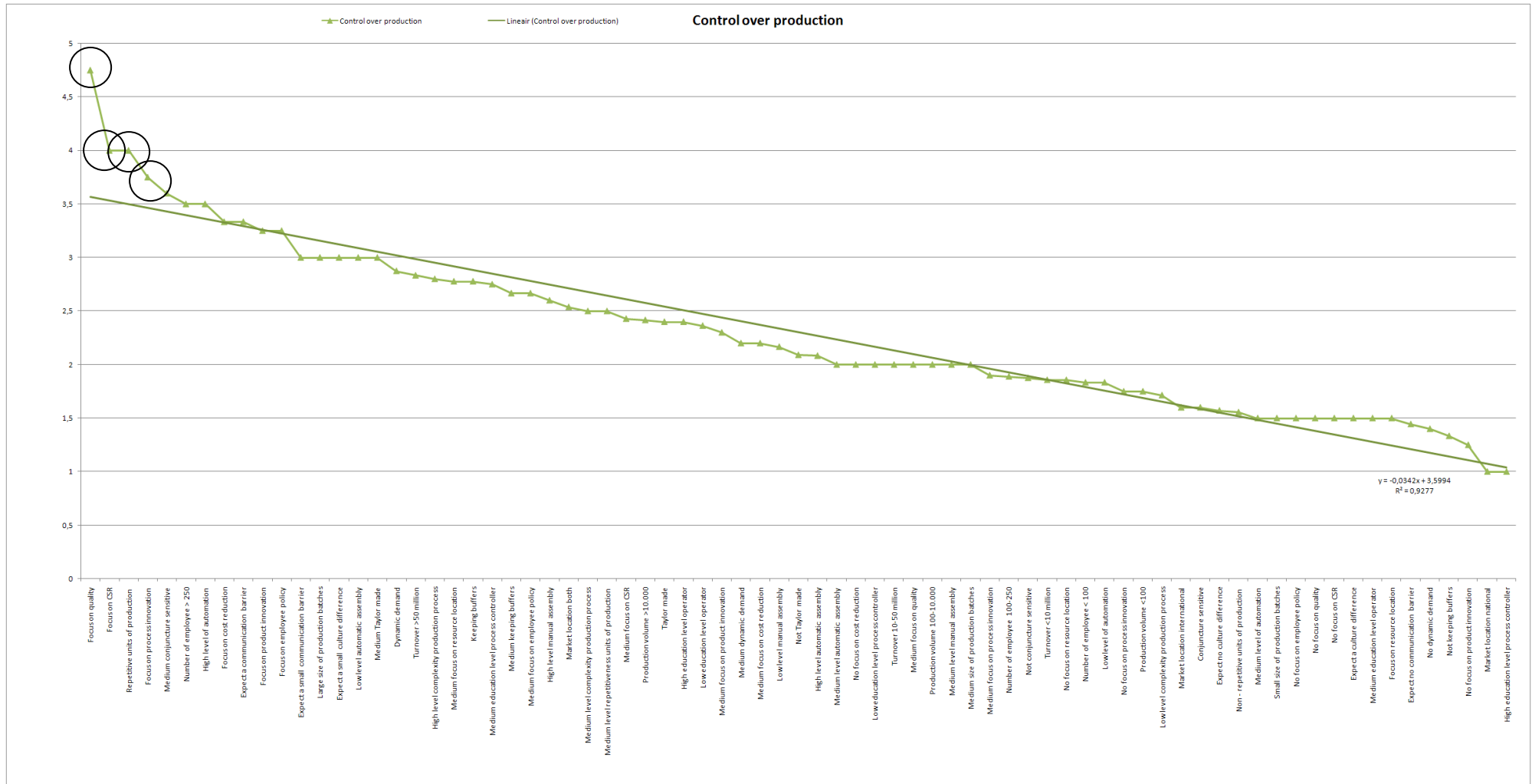


Figure 50: Strong relations for control over production

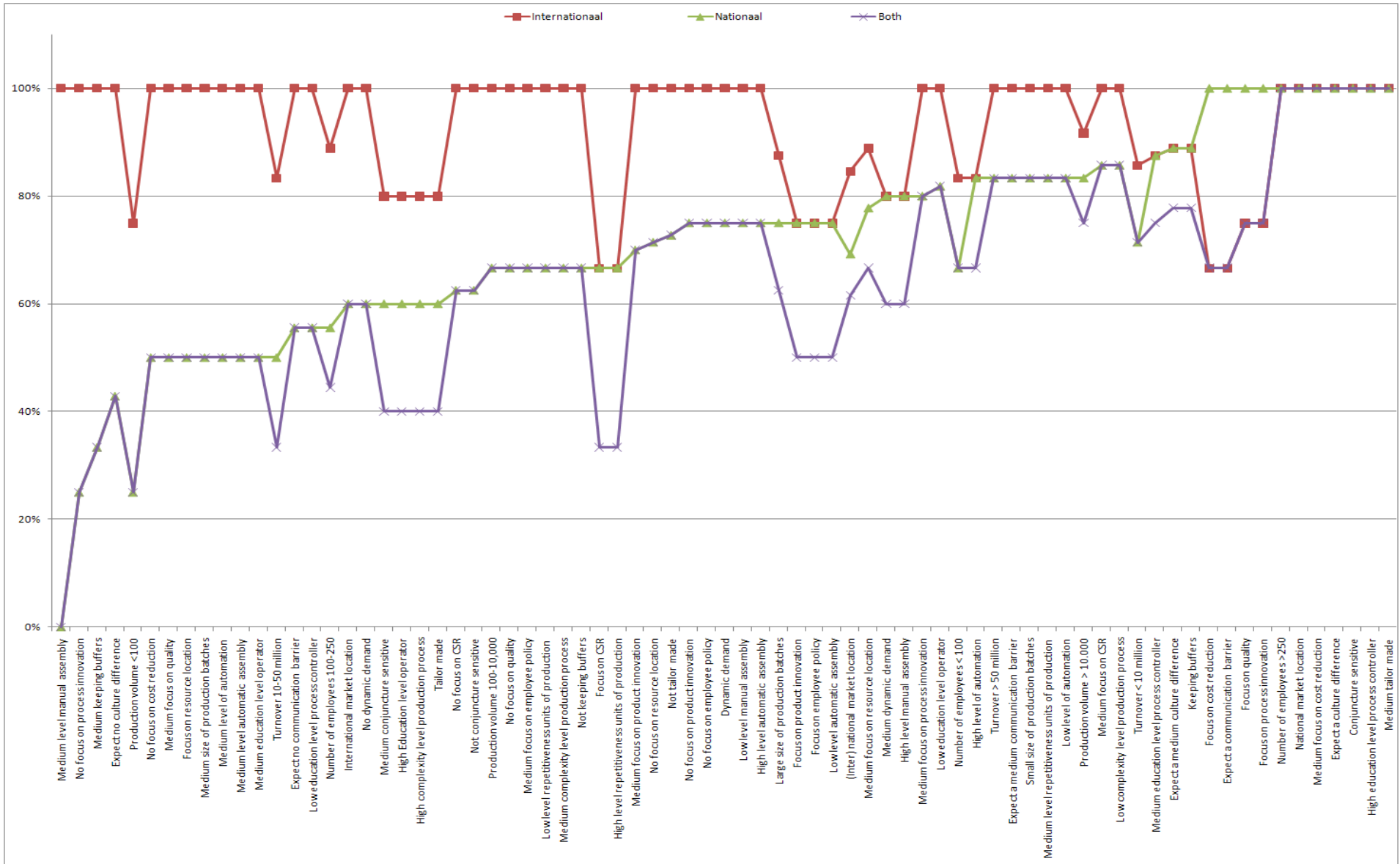


Figure 51: Influence independent variables on location variable



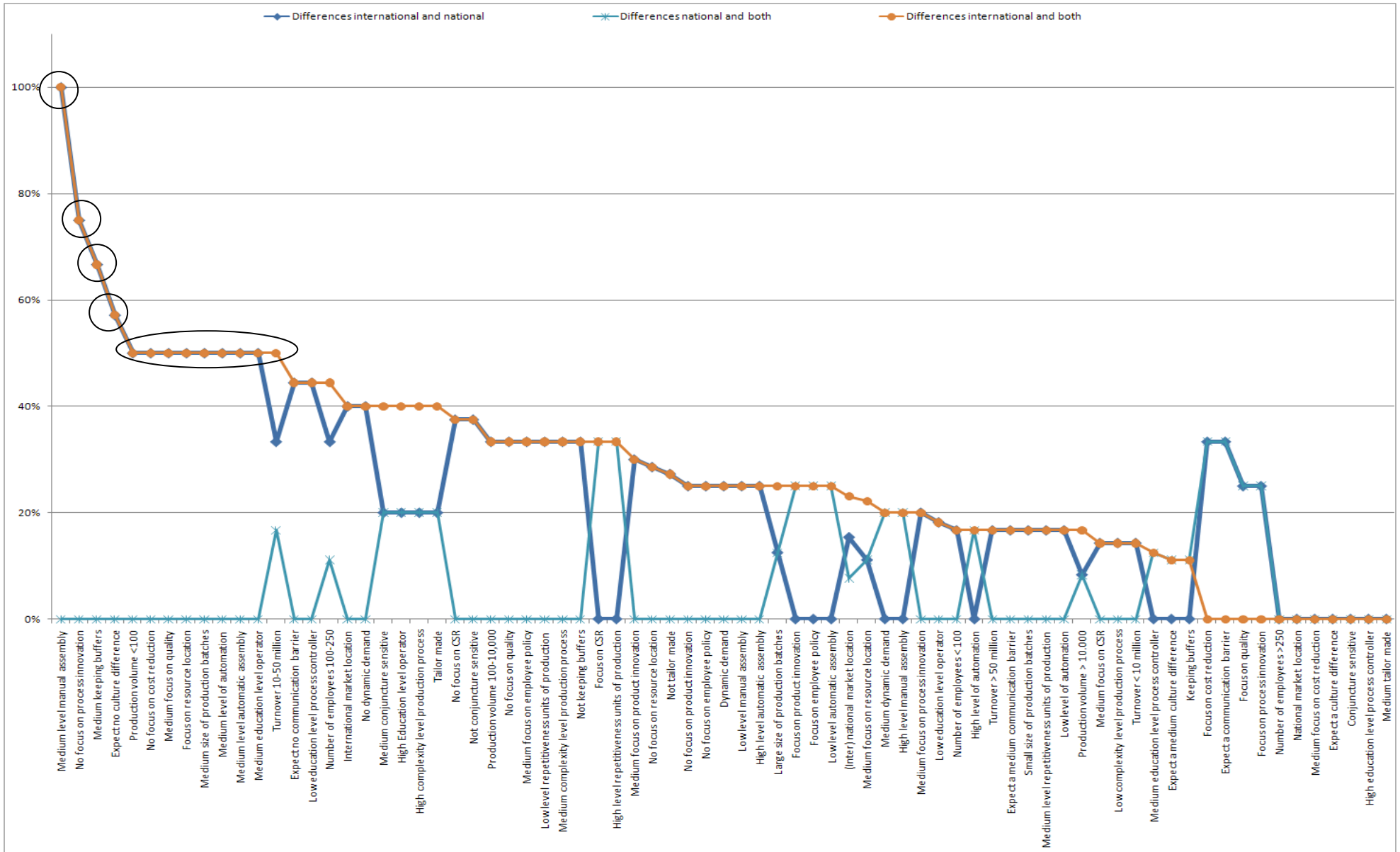


Figure 52: Differences between location variables



## 5.4 Answering the central question

**Central question: What is the relationship between outsourcing strategies and production systems?**

Based on the results of this research, not just one relationship could be suggested. Due to the large amount of variables, more than one relation is proposed. First, relations between the independent production system variables and the dependent management and control variables will be presented. Secondly, the relations between the independent production system variables and the dependent location variable will be presented. Finally, an overall conclusion will be presented regarding the central question.

### 5.4.1 Management and control

Considering the discussions in the sections above, three strong conclusions about the variables considering management and control could be formulated, based on the strong relations between production systems and outsourcing strategies:

- Organizations that produce products with an average sensitivity to market economy and organizations that focus on product innovation produce in ownership.
- Organizations that expect a communication barrier do not outsource production
- Organizations that focus on quality, focus on CSR or focus on process innovation have a high level of control over the production. Furthermore, organizations with a high level of repetitiveness of production batches have a high level of control over the production.

#### Organizational characteristics

With regard to the organizational characteristics, organizations with a turnover larger than 50 million, and organizations with more than 250 employees have a high level of control over the production. Organizations with a turnover between 10 and 50 million have a higher level of ownership compared with organizations with a smaller or a larger turnover.

Furthermore, organizations with the below mentioned managerial and physical characteristics, keep the production processes in ownership, and have a high level of control over the production.

#### Managerial characteristics

- Focus on cost reductions
- Focus on quality
- Focus on process innovation
- Focus on product innovation
- Focus on CSR
- Focus on employee policy
- Expectation of a communication barrier

#### Physical characteristics

- Large production batches
- Production units with a high level of repetitiveness

- High level of automated production process
- Low level of manual assembly
- High complexity production process
- Tailor-made products
- Keeping buffers
- High dynamic demand of product
- Average sensitivity to market economy

### 5.4.2 Location

With regard to the variable concerning location, it could be concluded that organizations that comply with the variables stated below, produce more often on international locations:

- No focus on process innovation
- Keeping an average amount of buffers
- No expectation of culture difference
- Production volume <100
- No focus on cost reduction
- Average focus on quality
- Focus on resource location
- Medium size of production batches
- Medium level of automation
- Medium level automatic assembly
- Operator with medium education level

### 5.4.3 Conclusion central question

With regard to the results of this research, the following could be concluded considering the relation between production systems and outsourcing strategies. Large, repetitive production batches are produced in own management. Furthermore, the production processes of these products are highly complex and require a high level of knowledge insensitivity. Therefore, with regard to the results of this research, it is concluded that till now, organizations are not outsourcing their core-processes.

The organizations focus on quality, process innovation, product innovation and cost reductions. With regard to the production process, it is concluded that organizations optimize their core-processes which results in process innovation, high quality and cost reductions. The expectation of a communication barrier and preventing dismissal of employees also results in production in ownership. Organizations that keep their production in ownership have located their production nationally. Small size production batches and production processes which require manual assembly are more often outsourced.

## 5.5 Limitations

Like all research studies, this research also has several limitations. This section outlines the limitations and gives a short reaction.

### Level of abstraction

A clear choice made at the beginning of this research, was to perform the research on a high level of abstraction. A disadvantage of a high level of abstraction is the risk regarding the external validity. The results of this research consist of generalized relations between production systems and outsourcing strategies, and do not necessarily hold good for every specific organization.

The conclusions of this research form a global basis for organizations, when in search of an outsourcing strategy.

### Low response rate

Although a lot of steps were taken to reach a high rate of response, a low response rate was achieved. The low response rate also threatens the external validity. A high outlier rating, or a low outlier rating for the independent variables, on the dependent variables resulted in a high influence on the findings of this research. However, it is impossible to omit outliers, because it is unknown whether the outliers or the other responses are correct. The response rate is too low to formulate a reliability interval. However, as described, dependent variables rated by only one respondent were omitted because these are clearly one-sided.

### Use of questionnaires

The use of questionnaires has its limitations, as realized while making the decision to choose for this method. It is possible that respondents misunderstood the question, or did not give themselves enough time to read the questionnaire carefully. The questionnaire was sent around Christmas and New Year, when several organizations have to deal with time pressures. Furthermore, as the questionnaire included questions about organizational strategy focus and operational activities, it is possible that one person does not have enough knowledge about these two different production system characteristics.

### Production system characteristics

It was very hard to describe production systems, due to the large variety of production systems. No clear research about production system variables could be found, which did not made it easier to clarify the production system. In hindsight, the research might have been stronger if a research of the production system characteristics had preceded.

## 5.6 Reflection

The goal of this research was to explore the relation between production systems and outsourcing strategies. In this reflection, the problems and bottlenecks of this research will be discussed.

Considering the results of the relation between managerial soft side characteristics and outsourcing strategies, this research shows decent findings, which can be very useful in the decision process regarding outsourcing. However, the physical characteristics are far more varied.

Partly due to the low response rate and the high level of abstraction, the relation between the physical hard side characteristics and outsourcing strategies is not very strong. It is possible that respondents have a different view of for example, complexity of production processes, education level and repetitiveness of production batches.

When is a production process regarded as complex, and when as not complex?

Misunderstandings about the questions could for example be prevented by interviewing the respondents instead of sending a questionnaire. When this research should be executed again, than a pre-research at the production system characteristics is advisable.

With regard to the research method, instead of large questionnaires, smaller questionnaires could result in a higher response rate. Furthermore, it could be advisable to combine survey research with face-to-face research and/or case studies. In this case, it can be examined if the respondents understand the questionnaire, and other factors which are not included in the survey could be noted.

When a larger response rate is obtained, it is advised to use SPSS instead of Microsoft Excel. SPSS provides more functions to present decent relations, and presents the confidence interval of calculations. In this research, calculating findings in Microsoft Excel did cost much time, and still no confidence intervals could be calculated.

The contribution of this research, consist of two points. First, this research provides a clear overview of abstract production system characteristics and outsourcing strategy characteristics. With the production system characteristics, every production system could specifically be described. Secondly, this research provides a view on the relation between production system characteristics and outsourcing strategy characteristics. These findings may serve as a guide during the outsourcing decision process. An organization could compare its production system characteristics with the findings of this research, while considering outsourcing.

This research does not suggest a theory, but provides scientists an overview of how production systems and outsourcing strategies are related.

## 5.7 Recommendations

The purpose of this research was to recommend the best suitable outsourcing strategy for the production of small-water-management products of Jansen Venneboer. The relations proposed in this research could figure as a guide while considering outsourcing, not only for Jansen Venneboer, but for all production organizations. It is recommended that organizations assess their production system on the basis of the proposed production system characteristics. The conclusions of this research recommend the best suitable outsourcing strategy.

### 5.7.1 General recommendations

Considering the results of this research, the following general recommendations are proposed:

- It is recommended for organizations that expect a communication barrier or a culture barrier to produce nationally

- It is recommended for organizations that focus on quality, CSR, process innovation, product innovation and employee policy to keep the production in ownership.
- It is recommended for organizations that have: larger production sizes, highly automated production processes, and highly complex production processes to keep the production in ownership of the organization.
- It is recommended for organizations that do not focus on cost reductions nor on process innovation to produce internationally

### 5.7.2 Recommendations for Jansen Venneboer

Jansen Venneboer is an organization with a medium-sized turnover (between 10 and 50 million) and with a medium-sized number of employees (between 100 and 250). Considering the organizational characteristics and the results of this research, it is recommendable to keep the production in ownership.

The production of small-water-management products requires the following managerial characteristics. First, the production of small-water-management products requires a focus on delivering quality. Secondly, the production of small-water-management requires a focus on product innovation. Jansen Venneboer does not produce small-water-management products on this moment. Furthermore, it is not the purpose of Jansen Venneboer to get more work by producing small-water-management products. Therefore, there is no focus on employee policy. The market of small-water-management products is highly competitive, which result in a required focus on cost reductions.

With regard to the focus of Jansen Venneboer on quality, cost reductions, and product innovation, it is recommended to keep a high level of control over the production process.

The production of small-water-management products has the following physical characteristics. The production batches of small-water-management products are small and are customer specific. The production batches are medium repetitive, and require a small adaption to the production batches, due to the customer specificity. The production process has a low automation level and has a medium complexity. The demand fluctuation of the products is small.

A conclusion of this research was that larger production sizes, highly automated production processes, and highly complex production processes should be kept in ownership of the organization. The characteristics of the production process of small-water-managements products does not match with this.

Considering the physical characteristics of the production of small-water-management products, and the results of this research, it is recommended to outsource the production. The main reasons for this is the low automation level, the low repetitiveness of production batches and the small size of production batches.

## Conclusion

With regard to the organizational characteristics, it is recommended to keep the production in ownership and control. Furthermore, considering the managerial characteristics it is recommended to keep a high level of control over the production process. Considering the conclusions of this research, a focus on cost reductions result in production in ownership.

To conclude, with regard to the organizational characteristics and managerial characteristics, it is recommended to keep the production in ownership and under control. Regarding the physical characteristics, outsourcing of production is recommended.

However, considering the conclusions of this research, it is recommendable to keep core-processes in ownership, and optimize this core-process. The production process of small-water-management products will not become a core-process of Jansen Venneboer. Therefore, it is recommended to outsource the production of small-water-management products to a national located organization. However, it is recommended to keep a high level of control over the production, due to the focus on product innovation and delivering quality. This could be realized by working with good agreements and contracts.

## 5.8 Questions for further research

During this research, new interesting questions for further research have come up. First of all, it could be interesting to study the relations between the different production system characteristics. Several suggestions for relations between physical and managerial characteristics are proposed in this research. However, it is expected that more relations can be set.

Secondly, it could be interesting to study the importance that organizations attach on the different production system characteristics. Which of the production system characteristics are most determinative during the outsourcing decision (organizational characteristics, managerial characteristics or physical characteristics).

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## Appendix A: Pioneering classification

Pioneering classifications		
Author	Year	Classification
Mallick & Gaudreau	1951	Continuous process Mass production Intermittent process
Wild	1971	Process manufacture Mass production Batch production Jobbing manufacture
Burbidge	1962	Line production BQ:1, TF: line Batch production BQ: more than 1, TF: functional Jobbing production BQ: same as order quantity, generally small, TF: functional Process batch production BQ: more than 1, TF: line Process jobbing production BQ: same as order quantity, generally small, TF: line
Burbidge	1971	Line production Line batch production Group batch production Functional batch production Line jobbing production Group jobbing production Functional jobbing production
Woodward	1965, 1980	Production of units to requirements Production of prototypes Fabrication of large equipment in stages Production of small batches to customers' orders Large batches on assembly lines Production of customers' large batches on assembly lines Mass production Intermittent production of chemicals in multi-purpose-plant Continuous flow production of liquids, gases and crystalline substances Production of standardized components in large batches subsequently assembled diversely Process production of crystalline substances
Conway et.al.	1967	Single machine Parallel machines Flow shop Job-shops

## Appendix B: Classifications derived by attributes

Classifications derived by attributes		
Author	Year	Classification
Johnson & Montgomery	1974	Continuous system Intermittent system a: intermittent flow-shop system b: intermittent job-shop system Large project system The pure stock system
Black	1983	Large project system Job shop Cellular manufacturing Flow shop Continuous system
Buffa & Miller	1979	Continuous system for stock Continuous system by order Intermittent system for stock Intermittent system by order
De Toni & Panizzolo	1992	Individual Unique Intermittent Discontinuous Repetitive Continuous
Wild	1995	Make from stock, to stock, to customer Make from source, to stock, to customer Make from stock, direct to customer Make from source, direct to customer
Pyoun et.al.	1995	Mass production Mid-variety and mid-volume Multi-variety and small volume
Jichao	1996	Simple production system Complex production system
Faunce	1977	Craft production system (low job specialization) Mechanized production system (high job specialization) Automated production system (low job specialization)

## Appendix C: Survey

Geachte heer/mevrouw,

Door verder toenemende (inter)nationale concurrentie- en prijsdruk (juist in de huidige moeilijke tijd zeer actueel), is een sterk groeiende groep Nederlandse producenten op zoek naar mogelijkheden om de integrale kostprijs van product(en) te verlagen en de beschikbaarheid en flexibiliteit van productie te vergroten.

Naast een optimalisering van interne bedrijfsprocessen wordt in die context steeds vaker gekeken naar uitbestedingsmogelijkheden in het buitenland. FME heeft die uitbestedingmarkten in kaart gebracht. Sinds enige jaren selecteert, bezoekt en kwalificeert FME zelf toeleveranciers in landen als o.a. China, India, Oekraïne, Slowakije, Roemenië, Litouwen, Turkije, Mexico, Vietnam en Thailand. Dit gebeurt op basis van technische competenties zoals bijvoorbeeld plaat- & lasconstructiewerk, verspanende bewerkingen, (spuit)gieten, elektro-mechanische assemblage, etc. Deze contacten hebben voor onze leden tot concrete inkoopvoordelen geleid waarmee op jaarbasis aanzienlijke inkoopbesparingen worden gerealiseerd.

U vraagt, wij draaien!, is ons motto en daarom treft U hierbij in samenwerking met de TU Twente, een enquête waarmee wij bekend willen worden met uw behoeften en wensen op dit gebied. Graag leren wij of U inderdaad net als velen anderen geïnteresseerd bent in de mogelijkheden van uitbesteding in Low Cost Countries (LCC's) of dat U van mening bent dat uw organisatie hier niet bij is gebaat.

Het invullen duurt slechts een paar minuten en op basis de resultaten zullen wij ons uitbestedingprogramma verder afstemmen op uw behoefte. Uw medewerking stellen wij ten zeerste op prijs waarvoor bij voorbaat reeds onze hartelijke dank!

Via de volgende link kunt U deelnemen aan ons onderzoek:

<http://www.enqueteviainternet.nl/3jwsebdft2>

Met dank & vriendelijke groet,  
Vereniging FME – CWM

Pepijn T.M. Bosman  
Business Development Manager  
Outsourcing & Offshoring

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E [peb@fme.nl](mailto:peb@fme.nl)  
I <http://www.fme-cwm.nl/>



Bent u ...

- Producent
- Engineering- / projectmanagementbureau
- Handelsfirma
- Anders:

Uw bedrijf heeft...

- <50 werknemers
- 50-250 werknemers
- >250 werknemers

De totale omzet in euro's van uw organisatie bedraagt per jaar...

- < 10 miljoen
- 10-50 miljoen
- >50 miljoen

Het productievolume van uw belangrijkste product per jaar is...

- < 100 stuks
- 100-10.000 stuks
- > 10.000 stuks

U verkoopt uw product...

- Nationaal
- Internationaal
- Beide

Wat is het termijn waarbinnen u internationaal wilt produceren?

- Ik produceer reeds in het buitenland
- 0-3 jaar
- > 3 jaar
- Ik verwacht niet in het buitenland te gaan produceren

Wat is het termijn waarbinnen u internationaal wilt inkopen?

- Ik koop reeds in, in het buitenland
- 0-3 jaar
- > 3 jaar
- Ik verwacht niet in het buitenland in te gaan kopen

Hoe groot is het jaarlijkse inkoopvolume van uw bedrijf (in euro's)?

Hoeveel besteedt u daarvan in Low Cost Countries (LCC's)

Binnen welke regio(s) bevindt zich uw productie en / of buitenlandse toeleveranciers?

- Oost-Europa
- Rusland
- Zuid Europa
- Noord West Europa (excl. Nederland)
- Nederland
- Zuid Oost Azië
- Azië
- Verenigde Staten
- Latijns Amerika
- Anders:

Binnen welke regio(s) verwacht of verlangt u in de toekomst te produceren en / of buitenlandse toeleveranciers te vinden? Gelieve deze vraag ook in te vullen bij verwachte of gewenste intensivering van productie of inkoop binnen een bepaalde regio.

- Oost-Europa
- Rusland
- Zuid Europa
- Noord West Europa (excl. Nederland)
- Nederland
- Zuid Oost Azië
- Azië
- Verenigde Staten
- Latijns Amerika
- Anders:

**Welke producten wilt u (op termijn) internationaal produceren of inkopen, of produceert of koopt u reeds internationaal in?**

Geen enkel product

Verspaning met normale toleranties

Kleine serie <100

Grote serie >100

Verspaning met (zeer) lage toleranties (precisie)

Kleine serie <100

Grote serie >100

Gietwerk

Zandgieten

Verloren wasgieten

Spuitgieten aluminium

Spuitgieten kunststof

Plaatwerk

Lasconstructiewerk

Mechanische assemblage

Electronische assemblage

Engineering

Software engineering



Kunt u aangeven in hoeverre de volgende aspecten bepalend zijn bij het vormen van uw productiestrategie (het daadwerkelijk uitbesteden)?

Een 5 staat voor zeer bepalend, een 1 voor niet of nauwelijks bepalend.

	5	4	3	2	1	
Prijsniveau	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Kwaliteit van uw product	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Afstand tot resources / geografische locatie	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Omvang / grootte van toeleveranciers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Beschikbaarheid van informatie over toeleveranciers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Referenties / trackrecord van de toeleverancier	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Innovatie binnen het productieproces	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Innovatie: productontwikkeling	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Maatschappelijk verantwoord ondernemen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Cultuurverschil	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Mogelijke communicatieve drempel	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Tevredenheid / behoud van Nederlands personeel	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	

Kunt u aangeven in hoeverre de volgende kenmerken van toepassing zijn op uw product, productieproces en / of de markt waarbinnen u opereert?

Een 5 staat voor zeer van toepassing, een 1 voor niet of nauwelijks van toepassing.

	5	4	3	2	1	
Uw product is economisch conjunctuurgevoelig	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
De vraag naar uw product heeft een hoge dynamiek	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Het product behoeft een minimale kapitaalsinvestering	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Uw product is een halffabricaat	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Uw gereed product vormt een productiemiddel voor andere productiebedrijven	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	

U produceert in serie	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
U ontvangt regelmatig repeat orders	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
De bewerkingen in het productieproces zijn maximaal geautomatiseerd	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Het product wordt handmatig geassembleerd	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Het product wordt automatisch geassembleerd	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Uw productieproces vereist hooggekwalificeerde toezichthouders	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Voor uw productieproces volstaan operators / medewerkers met een laag opleidingsniveau	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Uw productieproces is zeer complex	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Het uiteindelijke product is klantspecifiek / tailor-made	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Er worden voorraden van het gereed product aangehouden	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
U heeft volledige controle over het productieproces	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
U heeft het productieproces in eigen beheer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	