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"The development of a purchasing portfolio model for purchasing departments in hospitals during a crisis"

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Preface

This research is written for the Master Thesis for the study Business Administration at the University of Twente. This thesis is the effort of about six months writing and conducting research during the Covid-19 pandemic.

The subject of my thesis has been chosen based on my interest in healthcare purchasing and the influence of the current Covid-19 pandemic.

I would like to thank all the people that I was able to interview. I met many interesting hospital purchasers who gave me great insight. Furthermore, I would like to thank COPPA, Paul Gelderman, for their supervision and the opportunity to interview some of their hospital purchasers.

Lastly, I want to thank my thesis supervisors for giving me feedback and guidance while writing my thesis.

Barbara Tip

Enschede, 22 October 2020

Abstract

Purpose – The aim of this research is to develop a purchasing portfolio model for hospitals during a pandemic. The Kraljic matrix will be updated and different strategies, tactics and activities which were used by hospital purchasers during the Covid-19 pandemic were identified.

Design/Methodology/Approach - This study is a qualitative case study of different hospitals located in the Netherlands. Thirteen semi-structured interviews were conducted with among others hospital purchasers in the Netherlands. They were asked if they are familiar with the Kraljic matrix and which purchasing criteria they use. Hospital purchasers who worked during the Covid-19 pandemic were interviewed to find out how they experienced the Covid-19 pandemic and how they anticipated on products which became suddenly scarce.

Findings - In this study it became clear that one of the dimensions of Kraljic, namely strategic importance, must be redefined. It came forward that patient value is an important purchasing criteria for hospital purchasers. However, the respondents mentioned different definitions of patient value, which indicate that patient value is maybe a too vague concept. Furthermore, a consequence of the pandemic on the Kraljic matrix is that some items with low supply risk will change to (temporary) bottleneck items. These items will not change to strategic items, since a pandemic is temporary and the respondents mentioned that they did not developed long-term contracts with suppliers. Besides, different strategies and tactics are used by the hospital purchasers during the Covid-19 pandemic; inventory management, increase supply, reduce demand and innovation. Different new tactics and activities were identified, for example; converting appliances, awareness for cowboys, use alternative products, secure inventory and so on.

Research limitation – This study was carried out with a small research sample of thirteen hospital purchasers operating in the Netherlands. This limits the external validity of the findings since they might not be the same in other geographic areas in the world. This study could be expanded to other countries to validate the findings.

Originality/Value – There has been little research about purchasing portfolio models for hospitals yet and different scholars asked for further research. The concept of redefining strategic importance with adding patient value to the model is new. Next, different strategies and tactics for hospital purchasers, which are usable during a pandemic, are new aspects that got introduced to the research field which has not been assessed by other scholars.

Keywords – Hospital purchasing, Kraljic matrix, Covid-19, purchasing portfolio model, patient value

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1. Introduction: The need for developing a purchasing portfolio model for purchasing departments in hospitals during a crisis.

The world has experienced different natural disasters in the past decades including floods, wildfires, hurricanes, earthquakes, tsunamis, and pandemics. In 2003 the world suffered from the Severe Acute Respiratory Syndrome virus. Leading to damages and threats to human life and property (Cheng, Lau, Woo, & Yuen, 2007, p. 660) In 2009, the influenza virus was identified from an epidemic in Mexico, it spread rapidly throughout the world and was declared a pandemic (Falagas, 2010, p. 1). In 2020 the pandemic Covid-19 overwhelmed the world. As of early April 2020, over 1 million people have been confirmed with the coronavirus. Consequently, health care systems are overwhelmed, and effective delivery of care to patients has become a worldwide problem (Leistner, 2020, p. 1)

The different pandemics have forces health services and authorities to draft preparedness plans (Barlett, 2006; KW. Tsang, 2005). It is known that pandemics will occur every 30-40 years, so policymakers must take action in preparedness planning (Samina, 2012, p. 201). It is difficult for healthcare systems to prepare for a pandemic because of many uncertainties. A part of the healthcare system are hospitals. Hospitals provide a lot of different types of care. When there is a pandemic, the demand for care will increase. To deliver more care than usual it is likely that more products, for example, scalpels or mouth masks, will be used. The purchasing department of hospitals is the department that is responsible for the availability of the products in the hospital (Griffin, 2012, p. 217). It is also difficult for a purchasing department within a hospital to anticipate on a pandemic (Raoul, 2007, p. 1714). The Covid-19 pandemic generates a sharp increase in the demand for critical medical equipment and supplies to support the delivery of healthcare and to protect the safety of health care personnel. This has resulted in a shortage of key equipment and supplies in many countries, leading to bad performance of health services within hospitals. (Canada, 2020, p. 1)

To improve the performance of a hospital, not all purchased materials should be managed the same way (Gelderman, 2003, p. 207). This suggests that purchasing requires differentiation and classification of the resources. A lot of different models have been developed for the classification of resources, some of these models are widely used in practice to manage different types of products and services. (Bensaou, 1999; Kraljic, 1983; Olsen, 1997). The most frequently used model is the 2x2 Kraljic matrix (Kraljic, 1983), which categorizes products based on the strategic importance and supply risk, leading to four

different quadrants; noncritical, leverage, bottleneck and strategic. For each quadrant different strategic and tactical recommendations are available in the literature (Caniéls, 2005; Lysons, 2012; Van Weele, 2010). The tactics are used to translate the strategic approaches to ultimate activities (Hepsing, 2015; O'Brien, 2012). The traditional perspective of the Kraljic matrix suggests that purchasers must implement the strategic and tactical recommendations for each quadrant to maximize the performance of the company. However, different studies suggest that strategic and tactical recommendations are not the same for each product within one quadrant. So, not all the products in the same quadrant are to be managed in the same way (Gelderman, 2003, p. 209).

As a purchaser working at a hospital during a crisis, it is more important to know which strategy to use for which product. This, because when a pandemic occurs, there will be an increasing demand for vital medical devices, personal protective equipment and other healthcare products(Cain, 2020; OECD, 2020). It is crucial to avoid potential shortages, risk, or delays in the availability of such devices and products. To avoid these shortages, risk or delays, different strategies could be used. In literature, few is known on how to anticipate as a purchaser within a hospital on a crisis using portfolio purchasing models. Gobbi (2015) did a study on the need for collaborative purchasing when sourcing technologies for healthcare. They concluded that the buyer and supplier should look for alignment strategies and partnerships. Furthermore, Nudurupati (2015) conducted a study on the strategic sourcing process for a global health company using the Kraljic model. Medeiros (2018) researched how to classify health care related products within the Kraljic matrix. They questioned whether the four quadrants and the two dimensions of Kraljic are sufficient and appropriate for healthcare purchasing within hospitals. Remarkable is that this is the only study found who tried to classify health products within the Kraljic portfolio matrix. They indicate that there could be additions to the Kraljic matrix to make it applicable for hospitals. The fact that this is the only study found on the applicability of the Kraljic matrix on hospital purchasers, in combination with their conclusion, this study aims the following: *develop a purchasing portfolio model with different strategies for purchasing departments within a hospital during a crisis.* To do so, this research is guided by the following research question:

"How can the Kraljic portfolio matrix better capture the contingencies of hospital purchasing in a pandemic?"

The development of a purchasing portfolio model with different strategies for a purchasing department within a hospital during a crisis has not been developed yet. But the development of purchasing portfolio models for the industry have been conducted quite extensively (Andersson, 2010; Bildsten, 2014; Caniéls, 2005; Knight, 2014; Kraljic, 1983; Park, 2010; Segura, 2017). So, the theoretical application will be high because there is only one study available concerning the Kraljic matrix for hospitals (Medeiros, 2018). Besides the theoretical application, another strength of this study lies in the research design, which integrates purchasers who are working within a hospital during a crisis, namely Covid-19, and their experience will be applied within the model. So, this study will have important implications for purchasing portfolio practice and theory. The practical implications will be support with the answers on the following question:

"Which strategies and tactics where applied by hospital purchasers during a pandemic?"

To answer the before mentioned questions, first, the healthcare system in the Netherlands and the hospital market will be explained. Thereafter, concepts of different crises and the concept pandemic will be explained. Then, a review of the literature about purchasing portfolio models and hospital purchasing will be conducted. Subsequently, based on the information about hospital purchasing and crisis, a conceptual purchasing portfolio model will be developed. Finally, an overview of different strategies and tactics for (temporary) bottleneck items, used by hospital purchasers during the Covid-19 pandemic, will be developed.

2. Review: Hospital purchasing in the Netherlands

This chapter will describe the Dutch healthcare sector. Followed by the differences between the hospital market and the 'normal' market. At the end of this chapter, hospital purchasing will be explained.

2.1 The healthcare sector in the Netherlands

The healthcare sector in the Netherlands can be characterized as hybrid. There are three different market players, namely health insurers, healthcare providers, and insured people. They operate in different markets, health insurance market, healthcare purchasing, and health service provisions (see figure 1). The health insurance market is a market where insurers offer a package which is obligatory for al Dutch citizens. The healthcare purchasing market is where healthcare providers negotiate with the insurers on volume, price, and quality of care. Furthermore, in the health service provision market, providers offer care that patients can choose to use. (M.Kroneman, 2016, p. 24)

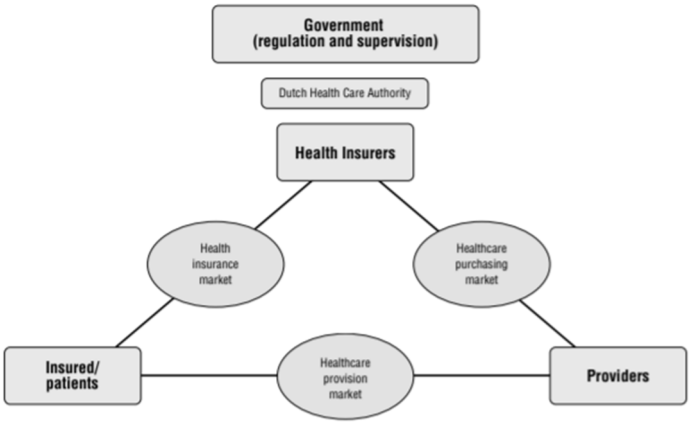


Figure 1; Dutch healthcare market (M.Kroneman,2016.p.22)

This research will focus on the healthcare purchasing market. Within the healthcare purchasing market, hospitals are an example of providers. In 2018, the Netherlands has 79 healthcare organizations, covering a total of 134 outpatient clinics and 120 hospitals (Rijksoverheid, 2020). Hospitals provide secondary care, almost always after a referral from general practitioners, but also from emergency wards. Care is provided at both outpatient and in-patient departments. (Sheshabalaya, 2010, p. 3)

Since 1990, concentrations and decentralization among hospitals and health insurers have been visible. A system of regulated competition is implemented in the Netherlands. Many hospitals started to operate on a commercial basis within a competitive environment since the 1990s. (Figueras, 2005, p. 39). Whereas the healthcare provision is separated from healthcare purchasing. Healthcare providers, in this case, hospitals, compete with each other to deliver care and services to people that are represented by healthcare purchases. They compete on a combination of price and quality. In a system of regulated competition, professional purchasing of products and services is a core element. (Figueras, 2005)

Since hospitals operate on a commercial basis and professional purchasing is a core element for the system of regulated competition, the focus of this research will be on the purchasing department of hospitals. To understand the purchasing department of hospitals, it is necessary to understand how the hospital market differs from a ´normal´ industry market. The following chapter will set out the differences between a hospital market and a normal market.

2.2 Differences between hospital market and a ‘normal’ market

This chapter will describe the differences between a normal market and a market where hospitals operate. Firstly, it is important to understand what a market is, which forms there are. Thereafter the differences between a normal market and hospital market will be explained.

The economic market is a ´place´ where buyers and sellers meet to respectively sell or buy their products and services in what economists call a market. It is the totality of the demand and supply for a particular product or service (Benson, 1990, p. 48). According to Heida (2016), there are two types of markets namely a concrete market and an abstract market. Most of the markets are abstract, which means that there is not a place that exists. A concrete market is an actual place where sellers and buyers actually meet. The comparison in this research will be made between a hospital market and an abstract market within the ‘normal’ industry.

Most hospitals in the Netherlands are privately owned and operate on a not-for-profit basis, but they operate within a competitive market. A competitive market is a type of market which applies a mechanism of demand and supply (Benson, 1990, p. 49). A consequence of the demand and supply mechanism is that the costs will be lower and suppliers will be more innovative. (Heida, 2016, pp. 22-25)

The competitive market has several characteristics namely, there are a lot of suppliers, the market is transparent, homogeneous products, firms can easily enter, the factors of production are perfectly mobile and transaction costs are not calculated. (Pathan, 2017, p. 6)

Hospital markets deviate from perfectly competitive markets. There are two types of markets, the competition of the hospitals regarding the patients, and the competition of hospitals and their supplier (M.Kroneman, 2016, p. 24) . The competitive market applies to both sides, hospitals have to purchase from suppliers and ‘sell’ to the patients. Both sides are related to each other, therefore in this study, the focus is on both the supplier side as the patient side.

Each hospital sells different products and services to their patients, which means that there are not only homogenous products. The patients are in this case the customers, these customers buy their products and services based on their preferences on ability and the personal match (Krabbe-Alkemade, 2017, p. 23). Patients are much more connected to a hospital, than customers to an ordinary company. Due to the close connection between

patients and hospitals, it will limit the substitutability of hospitals. Consequently, hospitals can increase prices or decrease some quality without losing all their patients to other hospitals (Krabbe-Alkemade, 2017, p. 115). If other companies increase their price or decrease quality it is more likely that they will lose their customers (Dranove, 2000, p. 245).

Furthermore, when patients will make a decision about which hospital to choose. They are usually affected by multiple actors, in addition to the patient himself, the referring general practitioner, the health insurer or the medical specialist will be involved in the decision. The decision process, which hospital to choose, is therefore much more complex than in 'normal' markets. In a normal market, a customer is most of the time not influenced by so many different actors. (Heida, 2016, pp. 24-25)

Summarizing, hospital markets differ from normal markets on the following aspects: the hospital market consist of two different sides, there are not only homogenous products, quality and price can easily be changed and the decision process is much more complex. To developed a purchasing portfolio matrix for hospitals, it is also important to understand how purchasing in healthcare is regulated, especially within hospitals. The following chapter will describe purchasing in Dutch hospitals. It will set out the different parts of the purchasing process and how it is applied in Dutch hospitals.

2.3 Hospital purchasing

This chapter will describe hospital purchasing and the corresponding characteristics. Dutch hospitals are permitted to make and retain surpluses (Figueras, 2005, p. 39). To retain surpluses it is important to have a well-established purchasing department and purchasing process. A purchasing process supports health care delivery and includes different activities related to managing inputs and purchasing (Myriam Lingg, 2016, p. 2). The central role of purchasing in hospitals is translating the needs of the population into the provision of health services. Taking the national health policy priorities and the cost-effectiveness of alternative products and interventions into account (Myriam Lingg, 2016, p. 2). Besides, a role of purchasing is to achieve savings and maintain the quality of the products and services (C.R.Carter, 2004, p. 167). Purchasing, where the focus of this study is on, is in the healthcare purchasing market (See figure 1). Within this market, insurers purchase care from providers, but another way of purchasing in this market is that hospitals purchase services and products from different suppliers.

When hospitals purchase products from suppliers, hospital performance can be improved with strategic purchasing. It brings a range of separate functions with the potential to improve responsiveness, effectiveness, and efficiency together. Besides, it can contribute to achieving public health goals and social objectives of equity within the healthcare system. (Josep Figueras, 2005, p. 11) In the Netherlands, purchasing is based upon a mix of health funds and private insurers. There is a great competition between the purchasing organizations (Josep Figueras, 2005, p. 16). All the different organizations work with almost the same purchasing process. This process can be described in the model of Weele (2018). The model of Weele (2018) is a general purchasing process and is at first developed for industrial procurement, but hospitals adopted this model in their procurement departments. The process includes different steps, namely; Internal customer, specification, selection, contracting, ordering, expediting and evaluation, follow up, and suppliers.

The purchasing process in hospitals is studied by different researchers. The supply chain management practices that are commonly used in hospitals are studied by Burns (2008)**.** Besides, the different factors that affect the supply chain of hospitals are studied by Chen (2013)**.** The most important and frequently used collaborative strategies, for improving the importance of the supply chain of a hospital, were inter-hospital alliance and the alliances of hospital suppliers. Furthermore, the effect of trust in suppliers on the performance of the supply chain and hospital supplier integration was studied by Abdallah (2017). They

confirmed that the relationship between hospitals and suppliers is based on trust, which improves the performance of the supply chain. Although the integration of suppliers and the hospital is uncommon in practices whereas it is more common in other industries (Abdallah, 2017, p. 705).

It is important to consider the hospital's purchasing operations as a priority when comparing to other processes. This because the purchasing operations can lead to competitive advantages, cost reduction, and the constant monitoring of the availability of stock for critical medical procedures. (Medeiros, 2018, p. 2) Despite the importance of purchasing, getting compliance from internal users is challenging and a crucial task for purchasers in hospitals. It is important to have top management support, although medical specialists have a major influence on the purchase of different products and services (Schneller, 2009, pp. 11-12). The selection of a supplier is frequently determined by a medical specialist instead of the purchaser of the hospital (Semeijn, 2018, p. 135).

When medical specialist selects a supplier, or give advice concerning which product to purchase, their focus of medical specialists is more on the patient value than profit. Surgeons' most important criteria for purchasing medical products are product quality and patient outcomes. Whereas general purchasers look for most price advantages and the lowest costs. (Bain & Company, 2018, p. 27)

Besides the focus on patient value, medical professionals, and healthcare organizations are bound to follow ethical codes. These four principles are respect for autonomy, beneficence, non-maleficence, and justice (Beauchamp, 2001; Gillon, 1994). The medical ethics as a field should not only cover healthcare professionals, but also developers of new systems, especially for new procurement systems. The four principles are a common discussion ground for different specialists in healthcare but also for authorities who make decisions about procurement processes or the development of healthcare systems. The principles have none-the-less been kept as the basic principles of healthcare. They should be implemented in the procurement systems as mandatory and should be extended with more specific guidelines for specific professions in healthcare. (Koskinen, 2012, p. 2)

In this chapter, different characteristics of hospital purchasing are mentioned. To reach the goal of this research, it is important to understand what purchasing portfolio models are and which models are developed for healthcare. The next chapter will describe different purchasing portfolio models in general and for hospitals.

3. Review: Purchasing portfolio models

This chapter will explain purchasing portfolio models in general. Thereafter the Kraljic matrix and other purchasing portfolio models will be elucidated.

Different studies assert that the purchasing strategy for products should be aligned with the strategy of the organization (Chen, 2013; Nudurupati, 2015). Besides, the management complexity of each product should be evaluated constantly because when a product is more important and critical for the organization, and the supply conditions are also more complex and uncertain, its management must be more important. Furthermore, it is also important to have distinct management models where the products and their suppliers must be put into different classes, also known as purchasing portfolio models. This because the purchasers can use different strategies for the different classes. Also, for critical products, the suppliers must be evaluated and frequently monitored, in particular, those products and suppliers that may save a patient's life. (Chen, 2013; Medeiros, 2018; Nudurupati, 2015)

Purchasing portfolio model can be defined as an analysis and diagnosis tool which has a prescriptive nature and is capable of identifying different items and categories (Caniéls, 2005; Kraljic, 1983; Olsen, 1997). The criteria and dimensions involved in such a model are the basis of the classification of items (Kraljic, 1983). The analysis of items and categories supports the avoidance of rupture in supply, manage the relationship with suppliers and it improves the bargaining power (Caniéls, 2005; Kraljic, 1983; Olsen, 1997).

There are different advantages of purchasing portfolio models. The main advantage is to understand the strategic importance of the products to purchase. This allows different actions to be taken for each group of product and their suppliers. Besides, purchasing portfolio models provides a framework to focus on and understand an organization´s supply strategy. (Gelderman, 2003; Medeiros, 2018)

Besides some advantages of purchasing portfolio models, there are also some critics. A key criticism of portfolio models is the measurement issues. Decisions based on portfolio models are sensitive to the choice of dimensions, weights, and factors. The classifications are arbitrary when it is not clear what the difference is between low and high supply risk or profit impact. (Gelderman, 2003, p. 208)

Different purchasing portfolio models are developed in literature. The more common approaches nowadays are based on the Kraljic matrix. The following section will describe the Kraljix matrix in detail, thereafter other purchasing portfolio models, mostly based on Kraljic, will be elucidated.

3.1 The Kraljic matrix

Kraljic (1983) developed a purchasing portfolio model which is most frequently used. This model classified the items according to two different dimensions. The first dimension is the impact of the item on the profit of the organization. This evaluates the strategic importance of the items. The second dimension is about the supply risk. This evaluates for these items the complexity of the supply market. Based on these dimensions, the items can be classified into four different categories. The categories are leverage, strategic, non-critical, and bottleneck items (See figure 2).

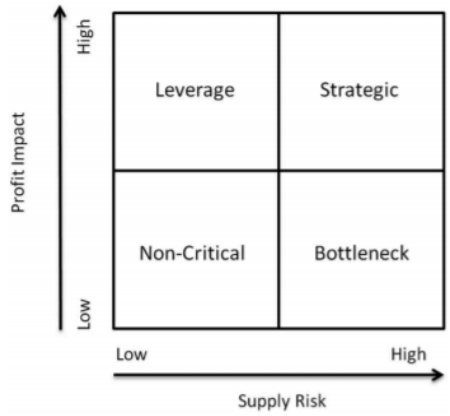


Figure 2; Purchasing portfolio model from Kraljic, (1983)

- Leverage items have a high-profit impact and a low supply-risk. This means that the expenditures are strategic important in a large marketplace with many suppliers. The diversity of suppliers allows the purchaser to negotiate, have a lot of power, and order volume optimization. (Kraljic, 1983, p. 111)
- Strategic items have a high-profit impact and a high-supply risk. These items can be purchased from all limited number of suppliers. It is important to forecast the demand, perform detailed market research, and other different analyses. (Kraljic, 1983, p. 111)

- Non-critical items have a low-profit impact and a low supply risk. This means that these products have low strategic importance and there are many suppliers available. The main focus is on reducing transaction costs through efficient processing. (Kraljic, 1983, p. 111)
- Bottleneck items have a low-profit impact and a high supply risk. These products are only available from a few suppliers and have low strategic importance. The focus in this quadrant is on the security of inventories and backup plans. (Kraljic, 1983, p. 111)

Each of these four categories requires different purchasing approaches. The approach for leverage items is based on value analysis, decision models, and price forecasting models. When a company needs to make supply decisions about strategic items, a large battery of analytic techniques need to be used to support these decisions. For example, risk analysis, market analysis, optimization models, price forecasting, and other kinds of microeconomic analysis. When there must be decisions made about non-critical items, simplistic analysis like market analysis and for example inventory optimization models are normally sufficient. Bottleneck items may require decision models for resolution and specific market analysis. More purchasing approaches for each category can be found in table 1. (Kraljic, 1983, pp. 112-114)

Table 1: Purchasing approach per category

Category	**Purchasing approach**
Leverage items	- Abundant supply - Targeted pricing strategies - Negotiation - Exploitation of full purchasing power
Strategic items	- Natural scarcity - Development of long-term relationships - Collaboration and innovation
Non-critical items	- Abundant supply - Product standardization - Process efficiency (automated purchasing)
Bottleneck items	- Innovation and product substitution and replacement - Low control of suppliers - Production-based scarcity - Search for alternatives

A limitation of this method is the number of criteria taken into account when classifying the products. The model only analysis products in terms of supply risk and profit impact. (Kraljic, 1983; Medeiros, 2018) Due to the limitations of the Kraljic matrix, different

purchasing portfolio models are developed based on Kralijc. The next chapter will describe some of these models and which additions are made to the Kralic matrix.

3.2 Other purchasing portfolio models

This section will describe recent research and development of purchasing portfolio models. Table 2 gives an overview of recent research and development of these models.

Table 2: Studies on purchasing portfolio models

Paper	**Goal**	**Difference to original Kraljic matrix**
Ghanbarizadeh (2019)	A purchasing portfolio model for the commercial construction industry	Examines the relations among the criteria and determines the degree of influence and permeability of each of them. This extended portfolio model offers more realistic solutions to today projects than the previous ones.
Medeiros (2018)	The development of an approach to managing a purchasing portfolio for a large Brazilian hospital, using Kraljic's purchasing portfolio model	A tool that analyses purchasing objectively, and avoids, taking only economic measures into consideration. Identified different categories of items that require special management.
Segura (2017)	Developing a system for qualifying providers and supplier segmentation	New strategic and critical dimensions to classify suppliers by using historical and reliable data needed in a system which will be able to support decision making at operative, tactical and strategic level.
Ferreira (2014)	Application of the Kraljic purchasing portfolio model	Classifying construction items in the Kraljic matrix.
Knight (2014)	Investigating the importance of purchasing skills for distinct purchase situations	Knowledge and skills on purchasing portfolio management, and its application in the strategic development of purchasing in an organization, and on human resource management in the purchasing function.
Drake (2013)	Portfolio model to classify products into agile and lean, agile, lean, non-critical	Two new dimensions; lean and agile.
Padhi (2012)	Methodology to classify and position commodities in the Kraljic purchasing portfolio model	Mapping works and services in the quadrants of Kraljic.
Lee (2010)	Portfolio model based on Kraljic purchasing portfolio model to evaluate the dimensions of competitive priorities and company size	Two new dimensions; risk in supply market and value.
Park (2010)	Portfolio model based on Kraljic purchasing portfolio model and Olsen (1997) to support the management of relationships with suppliers	Relative supplier attractiveness, relationship attractiveness.
Olsen (1997)	Portfolio model for evaluating the relationship with suppliers, considering the dimensions of the supplier's attractiveness and the intensity of the relationship	Supplier attractiveness and intensity of relationship.

Different new purchasing portfolio models are developed based on the Kraljic purchasing portfolio matrix (Drake, 2013; Ghanbarizadeh, 2019; Olsen, 1997; Segura, 2017). Padhi (2012) applied the Kraljic purchasing portfolio model to classify commodities while Ferreira (2014) did in the civil construction industry, Ghanbarizadeh (2019) on the commercial construction industry, and Medeiros (2018) for the healthcare industry.

Olsen (1997) develop a model with the same dimensions of the Kralijx matrix, however, they evaluated the relationship with suppliers, using dimensions of the intensity of the relationship and supplier's attractiveness. Drake (2013) developed a model intending to classify products as an innovation or functional thereby determining their suitability for agile or lean supply. They did not consider supplier management but limited their study to classification procedures. Segura (2017) developed a model where suppliers and products are classified based on critical and strategic dimensions. Park (2010) developed a matrix were transactional, strategic, and collaborative dimensions for products and the supply which are at high risk. Furthermore, Knight (2014) studied purchasing functions from a human resources management perspective. They considered that buyers require different skills and abilities for each category within the model.

As mentioned in this chapter, different purchasing portfolio models are developed, based on the model of Kraljic. It is clear what purchasing portfolio models are, and which examples are available in literature. The next section will describe what literature says about purchasing portfolio models for hospitals.

3.3 Purchasing portfolio models for hospitals

In the past chapter different purchasing portfolio models within the private sector are described, but the healthcare sector is rarely mentioned in literature. This chapter will describe the different researches on purchasing portfolio models for healthcare and especially hospitals.

Gobbi (2015) did a study on the need for collaborative purchasing when sourcing technologies for healthcare. They also used the Kraljic matrix and put the different products within the four quadrants. They concluded that the buyer and supplier should look for alignment strategies and partnerships.

Furthermore, Nudurupati (2015) conducted a study on the strategic sourcing process for a global health company using the Kraljic model. In this study, the facility management team was analyzed. So, they only used items that were not specific for healthcare.

Medeiros (2018) researched how to classify healthcare-related products within the Kraljic matrix. They did a case study within a Brazilian hospital. They classified twelve different products that are often used in hospitals. With a multiple-criteria approach they classified these products and the strategic purchasing strategy could be adjusted. They questioned whether the four quadrants and the two dimensions of Kraljic are sufficient and appropriate for healthcare purchasing within hospitals. Remarkable is that this study is the only study found who tried to classify health products within the Kraljic portfolio matrix.

So, there is little research been done concerning the use of purchasing portfolio models for hospitals or healthcare. The study from Medeiros (2018) is the only study who tried to classify health products within the Kraljic matrix. To evaluate products within hospitals during a pandemic, it is necessary to consider a larger set of criteria. To make a model that is applicable within hospitals, it is likely that new axis must be developed or existing axis must be redefined.

This chapter has described the difference between the hospital market and a ‘normal’ market, hospital purchasing, purchasing portfolio models, and purchasing portfolio models for hospitals and healthcare. Based on all this information, the next section will describe the possible redefining of the existing axis for the purchasing portfolio model.

3.4 Possible redefining of the existing axis `Profit impact/Strategic importance` with criteria: Patient value

As mentioned before, Medeiros (2018) did a study on purchasing portfolio models for hospitals. They questioned whether the four quadrants and the two dimensions of Kraljic are sufficient and appropriate for healthcare purchasing within hospitals. When the different aspects, such as influence on patients, of general hospital purchasing is combined with the existing purchasing portfolio models. It is likely that the dimension strategic importance, or profit impact, should be redefined.

As mentioned before, the central role of purchasing in hospitals is translating the needs of the population into the provision of health services. Taking the national health policy priorities and the cost-effectiveness of alternative products and interventions into account (Myriam Lingg, 2016, p. 2). Furthermore, the four principles of healthcare are respect for autonomy, beneficence, non-maleficence, and justice (Beauchamp, 2001; Gillon, 1994). Besides, in hospitals, purchasers get frequently advice from medical specialists when they purchase products and services. The focus of medical specialists is more on the health of patients than on profit for the hospital. Surgeons' most important criteria for purchasing medical products are product quality and patient outcomes. Whereas general purchasers look for most price advantages and the lowest costs (Baind & Company, 2017). So, the main difference between hospital purchasing and purchasing of industry companies is that hospitals have to purchase products that will have an influence on patients. The products to purchase can affect patients' health. For example, medicines. When a purchaser has to purchase medicine, it is likely that they have to take the influence on patient health into account.

Combining the statement of Madeiros (2018) with the difference between hospital purchasing and purchasing of industry companies, the first proposition can be developed:

P1: As well as taking account of profit impact - a captured in the Kraljic matrix – hospital purchasers consider patient value as an important criterion in product sourcing.

The conceptual purchasing portfolio model for hospitals, based on proposition 1, can be found in figure 2. A larger version can be found in Appendix 1.

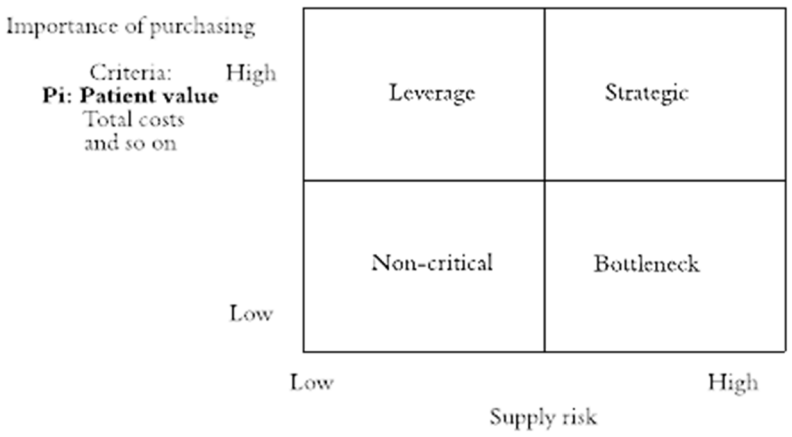


Figure 3: Conceptual purchasing portfolio model

The first part of this research, development of a purchasing portfolio model for hospitals, will be covered by proposition 1. In order to give an answer to the second part of this research, the concept crisis must be clarified. The next section will describe different types of crises. Thereafter, a pandemic will be used as an example of a crisis. The influence of a pandemic on purchasing will be explained. At the end of the chapter, different product categories which are influenced by the pandemic will be elaborated.

4. Review: Crisis and procurement

To develop a purchasing portfolio model for a hospital during a crisis, it is important to understand what a crisis exactly means and which types of crises can occur. This chapter will explain vulnerability factors for an organization and the different types of crises.

4.1 A crisis is an event developed through complicated processes, that affect an entire organization and cause extended damage.

There are plenty of definitions of crisis. A crisis can be defined as an event developed through complicated processes, that has an effect on an entire organization and can cause extended damage (Shrivastava, 1988, p. 286). Another way to define crisis is; a significant threat to operations that can have negative consequences if not handled properly (Liu, 2012, p. 380). Lebinger (1997) defines a crisis as "an event that brings or has the potential for bringing, an organization into disrepute and imperils its future profitability, growth, and possibly its very survival" (p. 4). According to Barton (1993), 'a crisis is a major, unpredictable event that has potentially negative results. The event and its aftermath may significantly damage an organization and its employees, services, products, financial condition, and reputation"(p.2.)

When surveying the above definitions, certain similarities appear to be prevalent. A crisis is an unplanned event with the potential to affect the external and internal structure of an organization. It can affect stakeholders, employees, key publics, and other members. A crisis may occur in any type of organization. (Barton, 1993, p. 3)

Crisis has a low probability of occurring but they can have severe consequences for a company when the crisis is not handled properly (Arpan, 2003; Cutlip, 2000). The most common consequences of a crisis are widespread negative publicity and a decrease in market share and sales(M. Griffin, Babin, B.J. and Attaway, J.S., 1991, p. 339). It is difficult to prevent and anticipate on a crisis (Pauchant, 1991, p. 227). For a company, it is difficult to avoid a crisis because it may happen at any time (Mitroff, 2000, p. 1).

4.2 Different types of crises

In literature, different vulnerability factors are described which influence the supply chain of an organization (see Table 3) (Pettit, Fiksel, & Croxton, 2010). Vulnerability factors are factors that influence an organization and can make the organization instable. Besides, different types of crises where described, for example, earthquakes, floods, disease**,** terrorism, and hurricanes (Tingru, 2014, p. 4). When looking at the vulnerability factors, Turbulence is the factors which summarize the different crisis.

Table 3; Vulnerability factors from Pettit et al. (2010)

Vulnerability Factor	**Definition**	**Sub-factors**
Supplier/Customer disruptions	Susceptibility of suppliers and customers to external forces or disruptions	Customer disruptions, supplier reliability
Connectivity	Degree of reliance and interdependence on outside entities	Degree of outsourcing, import and export challenges, scale of network
Sensitivity	Importance of controlled conditions for process integrity and product	Product purity, fragility, safety hazards
Resource limits	Constraint on output based on the availability of factors for production	Supplier, human resources, availability of raw material and utilities
External pressures	Influences that create business barriers or constraints	Political change, price pressures, environmental change, social change, competitive innovation.
Deliberate threats	Intentional attacks aimed at disrupting operations and causing harm	Terrorism, theft, labor disputes, product liability.
Turbulence	Environment characterized by frequent changes in external factors beyond control	Natural disasters, geopolitical disruption, unpredictability of demand, fluctuations in currencies and prices, Pandemic.

Fakhru 'l-Razi (2003) describes different types of crises, namely community, non-community, external crisis, internal crisis, economic crisis, and social crisis. A community crisis could be a natural crisis or an industrial crisis. An industrial crisis results from socio-technical disasters and natural crises from natural disasters. Non-community crisis is transportation accidents, which do not impact the functioning of the community. Besides, an external crisis is a crisis that can include wars, threats, relation breakdown, and terrorism. An internal crisis can include internal conflicts demonstrations, political systems.

This research will focus on a crisis that is a turbulence factor, community-related, external, and social crisis. An example of such a crisis is a pandemic. In this research, a pandemic will be used as an example of a crisis. The next chapter will explain the concept pandemic in more detail, and the effect of a pandemic on purchasing.

4.3 Pandemic as an example of a crisis

A pandemic has been defined as "An epidemic usually affecting a large proportion of the population**,** occurring over a wide geographic area such a section of nation, the entire nation, a continent or the world (Last, 1983, p. 131). According to the World Health Organization (2010) influenza pandemic occurs when a new virus emerges, spreads around the world, and most people are not immune. Pandemics occur approximately every 30 to 40 years and last approximately 1 to 2 years (Samina, 2012, p. 201).

Pandemics lead to a high number of people around the world who get ill. The impact of a pandemic is very high and will affect a large number of people in the population because they lack pre-existing immunity to the new virus. When a large population is infected, the total number of severe cases and the mortality rate can be large. (Organization, 2010)

Since pandemics influence health worldwide, it is likely that is also will affect the purchasing industry. Therefore, the next section will describe the influence of a pandemic on purchasing.

4.4 The influence of a pandemic on purchasing in general

A pandemic will influence purchasing and the supply chain in different ways. As mentioned before, a pandemic is spread around the world (Samina, 2012, p. 201). According to Ivanov (2020) pandemics are characterized by long-term disruption of the supply chain. Due to a pandemic, there will be a simultaneous disruption in supply and demand, and logistics infrastructure (R. T. Baldwin, E., 2020).

The disruption in the logistics infrastructure can be caused by different government measures per country. Some countries will have border patrols or will have a travel ban to decrease the spreading of the pandemic. These measures will lead to less export, difficulties in transport, resulting in problems with the delivery of products (R. Baldwin, 2020a, p. 20). According to Klaviyo (2020), 40% of the companies in their study encounter shipping problems, and 56% have problems in their supply chain.

Another consequence of a pandemic, is the decrease in availability of employees. The availability of employees will decrease, due to illness or lockdown measures. According to WHO (2020), Spain had to cut almost 900,000 jobs to fight the pandemic. When fewer employees are available, manufacturers and companies cannot produce the normal amount. Resulting in higher supply risk and product shortage. (R. Baldwin, 2020a, p. 13)

The consequences of a pandemic mentioned above, are related to the supply side of purchasing. It can be covered by the existing axis of the Kraljic matrix: supply risk. As mentioned before, supply risk is one of the existing axes of the Kraljic purchasing portfolio matrix (Kraljic, 1983). Despite, supply risk covers only a part of a pandemic. The next section will describe the influence of a pandemic on hospitals.

4.5 The influence of a pandemic on hospital purchasing

When hospitals experience a pandemic, the demand for certain healthcare treatments will increase. Certain surgical operations are postponed, while other operations or medical treatments have to be performed more frequently. As a hospital, it is important to have key devices available such as respiratory equipment. During the Covid-19 pandemic, a lot of people experienced dyspnea, shortness of breath, caused by the virus infecting the lungs. Due to the increase of patients with dyspnea, the demand for respiratory equipment will also increased. Especially during a pandemic, it is highly important to have this equipment available, to keep the system within the hospital running. (OECD, 2020, p. 10)

Another consequence of the Covid-19 pandemic is the increase in protective equipment such as mouth masks, face shields, hand canisters. Protective equipment will decrease the spreading of the pandemic and play a big role in safeguarding people from infection. Especially within a hospital, it is important to have all the protective equipment available. When protective equipment is not available, operations and treatments cannot be performed. Furthermore, increasing demand for intensive care beds is another consequence of a pandemic. During a pandemic, it is important to increase the capacity of a hospital and decrease the need for using emergency rooms or hospitals in general. (OECD, 2020, pp. 9-10)

As mentioned before, pandemics have different influence on products and the purchasing strategies. The following section will give a short overview of products that will change from category within the Kraljic matrix due to a pandemic.

4.6 The influence of a pandemic on hospital product categories

As mentioned in the chapter before, pandemics can cause decrease in demand for certain products. This section will describe, based on assumptions and early studies on the Covid-19 pandemic, how products will change from category within the Kraljic matrix.

OECD 2020 performed a study on the consequences of the Covid-19 pandemic on product groups. They identified an increase in demand for personal protective equipment. Personal protective equipment is a definition for different products such as protective N95 respirator masks, goggles, face shields and so on. According to Cain (2020) the global demand for personal protective equipment is higher than normal due to the coronavirus outbreak. Because of the increasing demand, less export, difficulties in transport, and thus problems with the delivery of products, the supply risk will increase (R. Baldwin, 2020a, p. 20). When the supply risk increase products will shift to the right side of the Kraljic matrix.

As mentioned before, a consequence of the Covid-19 pandemic is an increase of patients with dyspnea. Due to this increase, the demand for respiratory equipment also increased. Especially during a pandemic, it is highly important to have this equipment available, to keep the system within the hospital running. (OECD, 2020, p. 10). Besides, during a pandemic it is highly important to clean the patient rooms, but also washing the hands of the employees frequently. According to Berardi et al. (2020), the demand for disinfection products, for example hand sinisiter, increased rapidly worldwide.

Furthermore, to treat a corona patient, ventilators, medicine and (infrared) thermometers are necessary. Anticipated shortages of ventilators were identified as a big challenge for hospitals. Hospitals reported an uncertain supply of standard, full-feature ventilators and in some cases used alternatives to support (Grimm, 2020, p. 3). According to Kahn (2020), oxygen supplies have emerged as the latest choke point in the battle against the coronavirus. Many patients hospitalized with COVID-19 infections, have impaired lung function and require supplemental oxygen. Some hospitals experienced a shortage in oxygen.

If a corona patient needs to be treated with a respirator, they should be kept asleep. This happens with muscle relaxants, pain relievers and anesthetics. The demand for those specific medicines, for example propofol, has increased enormously (Roosmalen, 2020, p. 1). According to Silverman (2020), hospitals across the U.S. saw a surge in demand for drug when a study found that a cheap steroid reduced deaths by a third in hospitalized Covid-19 patients.

4.6.1 Pandemic influence on Kraljic: Both, several leverage items and routine items will rapidly change to (temporary) bottleneck items during a pandemic.

Based on the information above, assumptions of how products will change from categories within the Kraljic matrix can be made. Tabe 4 will show products that change to a category with high supply risk due to the high demand and the increase in supply risk.

Table 4: Classification of products

Product	**Category without pandemic**	**Category with pandemic**
Personal protective equipment	Non-critical items	Bottleneck items
Ventilators	Non-critical items	Bottleneck items
Disinfection products and cleaning supplies	Non-critical items	Bottleneck items
Oxygen	Bottleneck items	(temporary) Strategic items / bottleneck
Infrared thermometers	Non-critical	Bottleneck items
Respirators	Bottleneck items	(temporary) Strategic items /bottleneck
Medicines (Propofol)	Strategic items	Strategic items

All the products mentioned in table 4 will shift from low supply risk to high supply risk. When these products have a high supply risk, products with high profit impact/importance of purchasing will become strategic items, and products with low profit impact/importance of purchasing will become bottleneck items. Since a pandemic is temporary, the ‘new’ strategic items can possible be ‘temporary strategic items’ or bottleneck items.

Besides, as mentioned before, a pandemic is temporary and will last approximately 1 to 2 years (Samina, 2012, p. 201). Pandemics suddenly appear very quickly. The coronavirus spread all over the world in a few months. Because of this, the supply risk for certain products increased rapidly (R. T. Baldwin, E., 2020). Based on this information, it can be expected that the change from category will happen rapidly.

Summarizing, the consequence of a pandemic is an increase in demand for certain products and disruption of the supply chain. Which can lead to a shift of certain products from low supply risk to high supply risk products. Furthermore, it is possible that during a pandemic, high value items will not change to strategic items, because a pandemic is temporary and the Kraljic matrix and strategic items focusses on long term.

Based on the last section, it can be expected that products will generally change on the dimension of supply risk. Since a pandemic is temporary and appears quickly it can also be expected that these changes happened rapidly but are only temporary. So, the assumption can be made that leverage, strategic and routine items will change to (temporary) bottleneck items. Based on this assumption, it is likely that the strategies (see table 1) for strategic items will not be applicable for the before mentioned product categories during a pandemic. Based on this information, the second proposition can be developed:

P2: Both leverage items and routine items will change rapidly to (temporary) bottleneck items during a pandemic.

It is now clear what the expected influence is of a pandemic on hospital purchasing and different products categories. The next section will describe how purchasing departments of hospitals anticipated on a pandemic. Different (possible) strategies, of how to anticipate on products which rapidly changed to bottleneck items will be explicated.

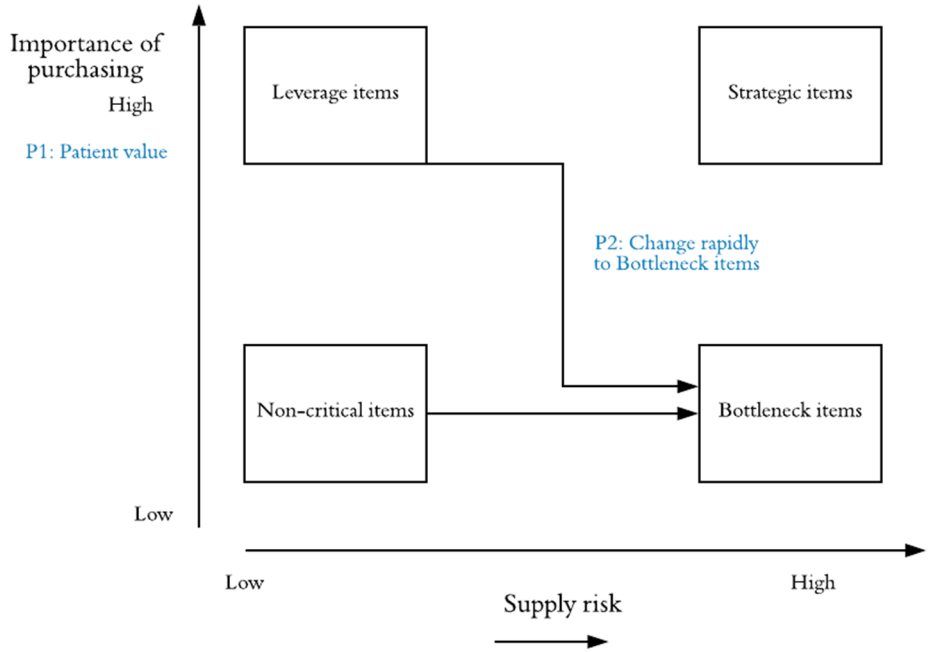


Figure 4; Purchasing portfolio model with P1 and P2

4.7 Different strategies of hospital purchasing departments on pandemics: Innovation and collaboration

As mentioned in the sections before, pandemics will have an influence on hospital purchasing departments. It is expected that some products will change from category in the Kraljic matrix. To anticipate on these changes, it is expected that hospital purchasers will use different strategies for bottleneck items than usual.

According to Bohmer (2020)**,** a strategy on how to anticipate on a pandemic is learning and innovating in real time. Innovating is a very broad concept. The study of Taylor (2017) mentioned different definitions of innovation. The research concludes that innovation can be identified with the improvement of existing products or services or the creation of a new service or product. In this thesis, innovation will be defined as: "the improvement and creation of new purchasing processes, strategies, products, services and methods of delivery which result in significant improvements in the purchase of products."

During the Covid-19 pandemic, the demand for N95 masks increased rapidly. In response to this shortages, many hospitals developed alternative designs for these mask which where suitable for interacting with non-Covid-19 patients. Some hospitals sterilized the masks and reused them. Other hospitals turned to non-medical-grade masks, such as construction masks (Grimm, 2020, p. 5). Any kind of innovation involves different risks, but under intense pressure there is not enough time to wait for definitive answers. So, hospitals and their purchasers have to be more innovative during a pandemic in order to meet the demand for bottleneck items (Bohmer, 2020). The following proposition can be developed:

P*3: During a pandemic, hospitals are more innovative in order to meet the demand for certain bottleneck items.*

Since innovation is a very broad concept, it is expected that different purchasing strategies will be covered by proposition 3. In this thesis two different examples of innovation will be used, based on studies from Bohmer (2020) and Grimm (2020). These two studies were conducted during the Covid-19 pandemic and therefor give recent examples of strategies used during a pandemic. A strategy mentioned by Bohmer (2020) is to coordinate and pool resources across different organizations. Since the amount of inventory which is required to meet a certain demand, it will decrease when the number of places holding inventory shrinks. Inventory requirements can be reduced by centralization because of the beneficial effects of pooling uncollated demand from different locations. Some hospitals will experience low

demand and have high inventory while other hospitals experience high demand and have low inventory. When these hospitals centralize, collaborate, the difference in demand and inventory will be balanced out. To get to pooling during a pandemic, it is essential to optimize inventory and break down departmental barriers within a hospital but also within the entire health care system. It is expected that during a pandemic hospital purchasers will collaborate more internally and externally. This will be an improvement on the existing purchasing process. Based on this information the following proposition can be made:

P3a: During a pandemic, hospitals/purchasers will collaborate more, both internally and externally in order to meet the demand for certain bottleneck items. (Centralizing procurement)

Another strategy which is used by hospitals to anticipated on the 'new' bottleneck items, is renting products from internal departments or external organizations (Grimm, 2020, p. 5). In the study from Grimm (2020), several US hospitals mentioned that they tried to obtain additional ventilators by renting them, getting through an affiliated facility, or by buying single-use emergency transport ventilators. Other hospitals converted other equipment, for example anesthesia machine, to use ventilators. Based on the information from US hospitals, and their strategy to secure ventilators, the following proposition can be developed:

P3b: During a pandemic, purchasers secure bottleneck items by renting products from internal departments or external organizations.

The above mentioned propositions are just an element of the strategies used in practice and are based on the studies from Bohmer (2020) and Grimm (2020). This research will show, which strategies hospital purchasers in the Netherlands used to anticipate on the rapid change of products with low supply risk to high supply risk. The results from the interviews used in this study are expected to give additional strategies to the existing strategies mentioned above.

In the theoretical section of this research, different propositions are developed. Based on these propositions the following model (see figure 5) is developed. A larger version can be found in Appendix 2. The model gives an overview of the purchasing portfolio model and the propositions

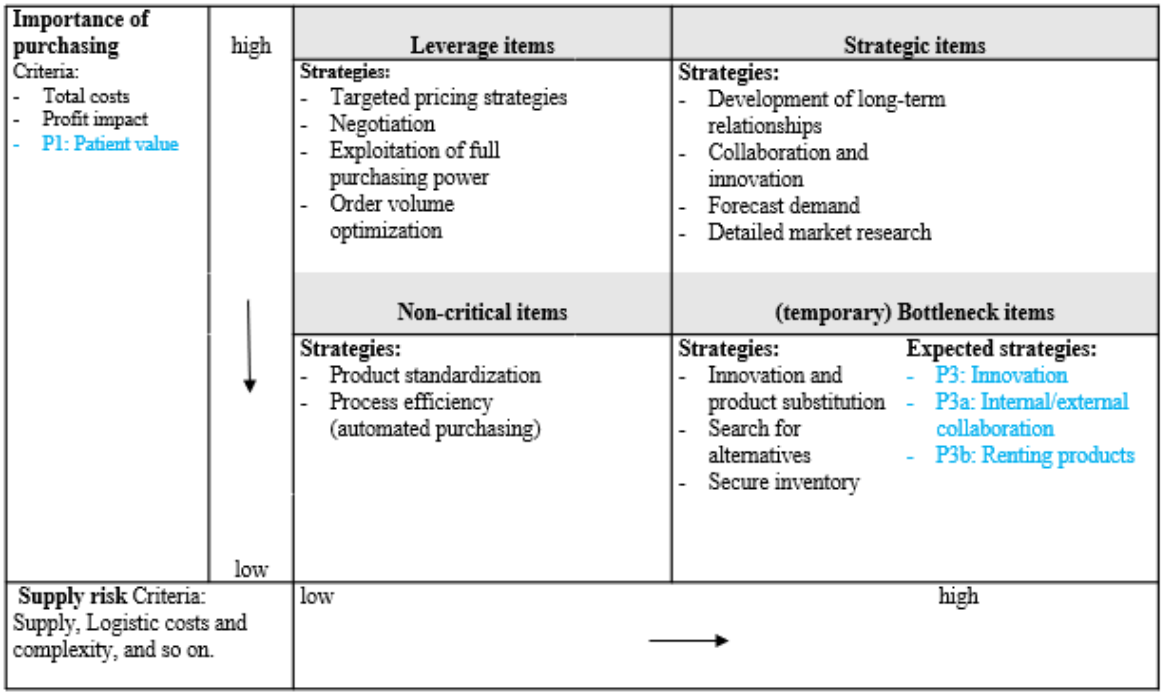


Figure 5: Purchasing portfolio model from Kralic with expected strategies

5. Methodology: Using interviews to update the purchasing portfolio model for hospitals during a pandemic.

The aim of this study is to develop a purchasing portfolio model for hospitals during a pandemic. To develop a model, different ideas, strategies and best practices of how to anticipate on a pandemic within a hospital must be identified. In this chapter, data collection and the data analysis will be explained.

5.1 Research methodology: Qualitative research

5.1 Qualitative research is suitable for analyzing different strategies and best practices of purchasers within a hospital

Quantitative research is frequently associated with collecting numerical data via surveys (Bryman, 2012, p. 9). Qualitative research is usually about collecting data from observations and interviews. It provides a inductive view by generating new theories out of research. The aim of such a research is to understand the social world by examining the different interpretations and opinions of people (Bryman, 2012, p. 9).

The most commonly used data collection method for qualitative research are interviews (Taylor, 2005, p. 39). Interviews can consist open and closed questions. Open questions can be valuable to learn more about how people think and feel about a certain situation. This way, the interpretations of purchasers how to anticipate on a pandemic within a hospital can be investigated and discovered. The most popular method for this type of data collection are semi-structured interviews because they are versatile and flexible (Bryman, 2012, p. 10)

In this study the case study will be used as a primary source. A case study method is chosen for the following reasons; according to Yin (2009), a case study is suitable when the focus of the study is to answer ‘why’ and ‘how’ questions. Case study can be defined as studying multiple or single cases with the goal to generalize to a larger population (Gerring, 2004, p 341). Some might say that case studies are based on the researcher’s interpretation and therefore are too subjective (Flyvbjerg, 2006, p. 219) Case studies are beneficial because it supports the investigation of a certain phenomenon in real-life and helps to understand complex issues(S.Jack, 2008, p. 544;552). In this research semi-structured interviews will be used to understand how hospital purchasers anticipated on the Covid-19 pandemic.

Therefore surveys will not be applicable to answer the research question because surveys are characterized by a systematic or structured set of data. The information will be collected for the same variables from at least two cases to compare between the different cases (Vaus, 2014, p. 5). In this research the variables are not clear yet, the variables will be fined based on the interviews. This is one of the reasons why a survey will not be applicable.

Furthermore, observations are also not applicable because observation techniques will observe the participants to collect data about a certain phenomenon. Most of the time, observations will be used to measure behavior and compare it with other cases (Altmann, 1974, p. 15). Since this study is about how purchasers anticipate on the Covid-19 pandemic, observations and surveys will not be applicable. So, a case study with in-depth interviews will be most suitable for this study.

5.2 Semi-structured interviews based on theory

In literature is described that the result of a case study is very dependent on the quality of the interview protocol since this protocol will give a structure for the semi-structured interview (Kallio et al, 2006). Therefore, an interview protocol is created to guide the researcher during the interview process. This interview protocol can be found in Appendix 3. To kick off the interview, first some introduction question will be asked, for example: *"Can you tell me a bit about your job and work experience?"*

The following section will introduce the research sample.

5.3 Sample definition and data collection

There are different methods to select the sample for the research. When selecting the research sample the sample method must suit the assumptions and aim of the research (Palinkas et al, 2005, p.534). When selecting the participants for the research, they must also suit the assumptions and aim of the research. In this study, purchasers who work at Dutch hospitals will be included. Potential participants were messaged and asked to take part in this research. A total of 13 purchasers are included.

The primary data of this research will consist of 13 in-depth semi-structured interviews with hospital purchasers. These purchasers worked at major hospitals with full emergency and critical care units. One respondent is also coordinator at ROAZ. All interviews are recorded and afterward transcribed into text documents. Thereafter the text documents are coded to identify the most important and most mentioned attributes regarding collaboration.

Tabel 5: Qualitative sample overview

Respondent	Organization*	Function	Interviewed via	Duration
1	x	Purchaser	Teams	41:12
2	x	Medical equipment coordinator/Purchaser	Teams	49:17
3	x	Purchaser	Teams	37:43
4	x	Purchaser	Teams	35:21
5	x	Purchaser	Teams	41:43
6	x	Partner/Coordinator/Purchaser	Teams	22:14
7	x	Purchaser	Teams	28:01
8	x	Purchaser	Teams	41:34
9	x	Purchaser	Teams	50:59
10	x	Purchaser	Teams	43:41
11	x	Purchaser	Teams	31:56
12	x	Purchaser	Teams	37:04
13	x	Purchaser	Teams	40:04

*The organizations are anonymized

As can be seen in in Table 5, the interview duration varies, ranging from 22:14 minutes to 50:59 minutes. It was notices that some interviewees shared more detailed information and were generally more talkative. Which explains the longer duration of some interviews. Overall, some interviewees were less invested in the interviews than others. This explains the shorter duration of some interviews. In the shorter interviews, the interviewees tended to give not many details and shorter answers. Another explanation of the differences in durations is that people speak with different speeds. Some interviewees did not have to think long for reply, and soke quick, resulting in an overall shorter duration.

5.4 Codes used to analyze the interviews

With permission of the interviewees, the interviews got recorded within Teams and afterwards transcribed. The transcripts must be analyzed in order to develop concepts from qualitative data (Huq Khandkar, 2009, p. 1)**.** Since different propositions are developed in earlier chapters, it got decided to use them as the main codes. The following codes were used to analyze the transcripts:

P1: Rejection, P1: Acceptance, P1: No opinion, P2: Rejection, P2: Acceptance, P2: No opinion, P3: Acceptance, P3: Rejection, P3: No opinion.

Based on these codes, other codes are developed in order to substantiate the different views on the different propositions. Since, it is recommended to code as soon as possible, shortly after the interviews took place, the interviews got coded (Bryman, 2012, p. 576). At the beginning of the coding process it is necessary to read the different transcripts multiple times in order to find the first connections. Thereafter the different codes were assigned to different parts of the transcripts. To check whether connections could be made, or codes should be added, the codes must be reviewed over and over again. After the coding process, popular views and interpretations will be used to substantiate the propositions. The outliers, unusual responses and quotes that contradict to the other data will be used to discuss the different propositions. (Bryman, 2012, pp. 576-577)

6. Results: Testing the propositions with the findings from the interviews

This chapter will describe the results of the interviews per proposition. All interview transcripts can be found in Appendix 4.

6.1 Findings proposition 1: As well as taking account of profit impact - a captured in the Kraljic matrix – hospital purchasers consider patient value as an important criterion in product sourcing.

The following describes the findings concerning the different views and purchasing criteria of hospital purchasers. 2 out of 13 do not have an opinion about the purchasing criteria. They either do not mention it or they simply do not know if patient value is an important purchasing criteria (See figure 6).

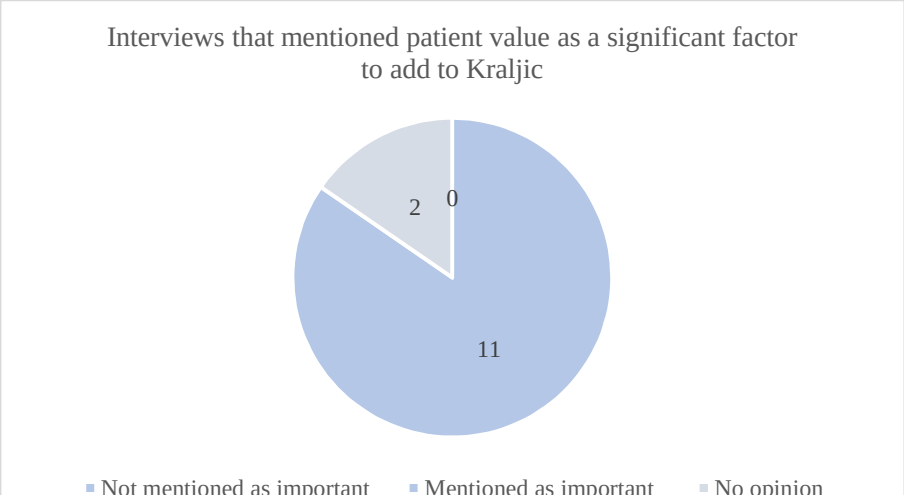


Figure 6; Proposition 1: respondent mentioned patient value (n=13)

Respondent 5 mentioned the following criteria *"Main goal, added value for the organization. Availability and price. The coronavirus had shown that the availability of products is very important'.* The respondent did not mention anything about the influence on the patient. The other 11 respondents mentioned that patient value is an important purchasing criteria, but they mentioned different definitions and interpretations of patient value. Different reasons for including patient value where mentioned *"Patient safety must be guaranteed. The products must comply with the quality marks. The infection prevention department must agree on this aspect.."* (respondent 12). *"It is important that someone from the primary process is involved. To get a clear view of what is the impact on the patient and client when we talk about these products and services"*(respondent 4). Some of the

respondents mentioned that patient value is more important than price. *"Spend as little as possible but keep to a certain quality standard"* (Respondent 7). While other respondents introduces the concept price-quality and stated that it depends per situation and product *"Price-quality where quality is based on value for the patient. We always work with weighting criteria, where price and quality are criteria. I cannot say that one is more important than the other. It depends on the products and the main goal.."* (respondent 11).

Overall, quality is an important purchasing criteria. Based on the different interviews, patient value can be considered as a highly important purchasing factor. Most of the health care purchasers take automatically patient value into account. It is included in the purchasing process. *"We always take the interests of the user and the patient into account"* (Respondent 10*.) "Patient safety, patient friendliness, are the two factors which are on top of our priority list"* (Respondent 9).

As mentioned before, it seems to be that hospital purchasers have different interpretations and perspectives on patient value (see figure 7). It depends on the person and the organization how they interpretate patient value. Based on the different views of the hospital purchasers on patient value, it can be stated that there is a certain degree of **support** for proposition 1 but the definition patient value is too vague.

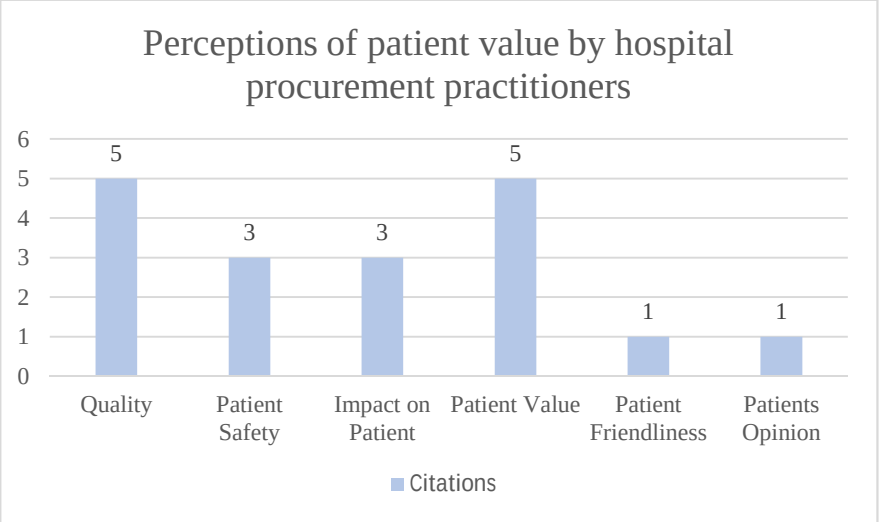


Figure 7; Interpretations of patient value (n=11)

6.2 Findings proposition 2: Both leverage items and routine items will change rapidly to (temporary) bottleneck items during a pandemic.

The first part of this chapter will describe the findings concerning the leverage items and routine items changing to (temporary) bottleneck items. Thereafter the findings concerning the rapid change from category will be described.

6.2.1 Findings: Leverage items and routine items will change to (temporary) bottleneck items

During the interviews, it became clear that all the respondents were familiar with the Kraljic matrix. Most of the respondents still use this purchasing portfolio model for purchasing within hospitals. Respondent 7 mentioned *" no matter how old the model is, we still use the model to indicate where our changes are. What the value is and what the risks are for the organization. So certain product groups are still placed in the different quadrants"*

Based on the familiarity of the respondents with the Kraljic matrix, the different categories were discussed and the consequences of the Coronavirus on the purchasing department where mentioned. The most important, and frequently mentioned consequence was the sudden scarcity of personal protective equipment. Respondent 10 mentioned *"once the coronavirus was in the Netherlands there was a big shock effect. As a result, the shortage of personal protective equipment was underestimated very quickly and it became very quickly core business."* Another respondent told *"There was a worldwide run on personal protective equipment. This made these products very scarce"* (Respondent 2)

They also mentioned that personal protective equipment usually is treated as a routine product, because there are a lot of suppliers and usually no shortages. "*normally we buy the products by negotiating with a certain supplier, and we make agreements about the price and develop a contract. Suddenly the personal protective products became scarce, which is normally not. We suddenly had to purchase personal protective equipment very ad hoc with very large volumes. That is very different from what we normally work.* (Respondent 12). Respondent 1 confirmed on a part of proposition 2, *"During Corona, a routine product became a critical product and it became also a critical product for the supplier. That actually applied to everyone. Those supplies were quickly exhausted. The whole world popped up on those stocks, it was complete chaos.* Respondent 11 also confirmed proposition 2: "*You have to be aware that they shift in that matrix. Where a product was primarily about competition*

and be as cheap as possible. Now it was about securing and having the product in house. You have to be aware of that, and feel that it is happening. As it now happens again that they shift back to routine. Where availability was first in the corona time, and price was secondary. You just have to be aware of it"

Furthermore, the interviewees did not mention any other leverage products that became scarce. They mentioned the PPI, and some other routine products, for example, respondent 3 "*the focus was on personal protective equipment. The newspapers were full of that. But bandages and different kinds of plastic disposables that were used in hospitals also became scarce.* Respondent 13 mentioned *"I think it started with meshes from Wuhan. That was the first thing we noticed. Then the huge wave with masks really started. Insolation jackets, also called the OR coats. Hats. Gloves were very scarce at one point. Alcohol was scarce from the first day. And along the way, when the ICs were full, ventilation disposables became the big bottleneck. And it still is today"*

Furthermore, all different respondents mentioned that they did not concluded new contracts with new suppliers or their existing suppliers. They only ordered once or twice from the supplier and did not develop new long-term contracts with the suppliers. "W*e only made short term contacts. We needed certain products immediately, therefore we purchased them very quickly"* (Respondent 12). Respondent 8 *"It makes no sense to conclude contracts for several years at the moment because nobody knows how long the pandemic will take… we only have to make sure that we have enough stock and no shortage"*

The concluding of long-terms contracts, is a strategy for strategic items, and usually not for bottleneck items. Based on the examples of the interviewee concerning the shift of personal protective equipment from routine items to bottleneck items. And that they did not use long-term contracts with the new suppliers. In combination with the information from literature, pandemics are temporary and the Kraljic matrix focusses on the long term. There is sufficient information that **support** the first part of proposition 2.

6.2.2 Findings: Items will rapidly change from category

All the respondents indicated that they were very shocked by the rapid spread of the coronavirus. It caused panic and chaos in the hospitals and health care organizations. *"Everyone knew it would be a matter of waiting, but when will it arrive in the Netherlands? Once the coronavirus was detected in the Netherlands, there was a shock effect… What should we do now..?*(Respondent 10). Some respondents indicated that the corona outbreak and the accompanying panic, could not have been prevented. Other respondents mentioned that if we looked at the developments in China, we should have known that the coronavirus would spread quickly around the world. *"If we listened more to China, we could have responded much faster to the demand for personal protective equipment, and the pubs would have been closed earlier. Then we could have smoothed out the first wave"* (Respondent 10). Due to the rapid spread of the virus, the demand for personal protective equipment increased rapidly. Respondent 9 mentioned: *"The internal demand for personal protective equipment increased very quickly and with a large amount. Because the worldwide demand for these products increased also very quickly, the suppliers ran into problems with being able to deliver the correct amounts of products to the organizations".* Later on, Germany and France were no longer allowed to export their products to the Netherlands. This meant that some respondents could no longer get their products from Germany and France. This happened over several weeks (Respondent 6). During the interviews, it became clear that everyone was surprised and shocked, both organizations as the employees. Nobody could have really foreseen this, and the rapid change to scarcity created a lot of panic, chaos. *"We had no time to arrange all that financially. Time was simply lacking during the pandemic. There was panic and chaos, there was no time for other tasks"* (Respondent 7).

It also became clear that the main goal of the purchasers during the pandemic was to get the products. It does not matter where the products came from, as long as they were qualitative good products. They did not use the usual purchasing strategies. *"make sure you get the products. They said it, just make sure you have it"* (Respondent 11)

Since the different respondents indicated that there was panic and chaos within the organization, some tasks were not executed. And the demand for personal protective equipment increased rapidly both nationally as worldwide and caused worldwide scarcity. In combination with the information from literature. There is sufficient **support** for the last part of proposition 2. In conclusion, there is enough information that supports proposition 2 so proposition 2 can be **accepted.**

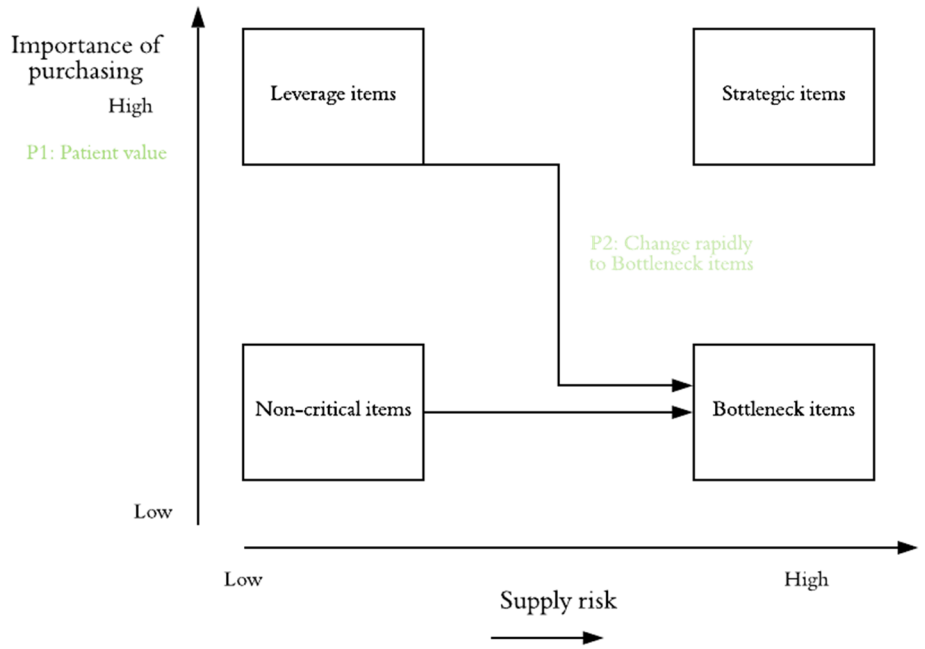


Figure 8; Acceptance P1 and P2

6.3 Findings proposition 3: During a pandemic, hospitals are more innovative in order to meet the demand for certain bottleneck items.

During the pandemic, the demand for N95 masks increased rapidly. In response to these shortages, many hospitals developed alternative designs for these masks which were suitable for interacting with non-Covid-19 patients. During the interviews, the respondents did not mention anything about developing alternative designs. They did not do this by themselves. The hospitals did use other kinds of masks, for example, construction masks, face masks, and other types of masks. Many hospitals used different masks to prevent a shortage. *"There was a shift in the different types of masks. From type 2R, to FFP2"* (Respondent 8). Respondent 3 mentioned, *"Masks A is replaced by masks B. The functionality has remained the same, only the product is different".* Respondent 4 mentioned that they use alternative products to meet the value of the patient *"We have different hard of hearing, and deaf clients. We have purchased alternative products, for example, the face masks.*

Another response to the shortages of personal protective equipment is sterilizing and re-using the products. Almost every respondent mentioned different ways of how they sterilized and re-used the products. Some hospitals sterilized mouth masks and jackets. Respondent 1 mentioned: *"At a given moment, we sterilized the 3m mouth masks and could use them 5 times instead of 1. We also did this with the jackets. Ultimately, this was also taken up nationally by several laundries. We have also made use of that."* Another hospital purchased another type of isolation jacket. This type was washable instead of deposable. *"We bought 600 coats and are now running a pilot. As a result, we have at least a fixed stock of coats. Only it is much more expensive"* (Respondent 2).

Besides sterilizing and re-using products, some respondents mentioned other innovative ways to get their products. Respondent 11 indicated that there were shortages of infusion pumps. They bought second-hand products from a bankrupted hospital and used them again. *"We bought some infusions pumps second hand from a bankrupted hospital. These have been reset by our medical technology so that they could be used again".* They also mentioned another innovative way to get their bottleneck products. They had problems with purchasing resuscitation systems. *"we had to order some parts separately and assemble them in the hospital. And so the resuscitation kits remained in stock. It is maybe a bit unprofessional, but the product works the same.* At a certain point, it became clear that regular care was temporarily canceled. In the hospital of respondent 9, they transformed certain departments

to corona departments. All they also used the products to help corona patients. For example sterilization systems and ventilation systems. They used different products more efficiently and smartly. Respondent 5 was able to obtain 6 more respirators because they converted existing anesthesia equipment. Based on the different statements from the respondents, there is a certain degree of **support** for proposition 3.

P3a: During a pandemic, hospitals/purchasers will collaborate internal as well as external more in order to meet the demand for certain bottleneck items.

To anticipate, as a health care purchasing department, on scarce products, different strategies are used and mentioned by the respondents. Literature indicated that there will be more collaboration between employees, and also between the organizations, during a pandemic. During the interviews, various reasons and examples of collaborations have been mentioned.

All the respondents said that despite working from home, there was much more collaboration with other employees during the pandemic. Various working groups and crisis teams are developed. Other respondents mentioned that the purchasing department has contact and was involved with a lot of different departments. Respondent 8 indicated *"The crisis team was developed during the pandemic. The crisis team included purchasing, facility management, logistics people. Department warehouse, central warehouse, everyone participated"*

Some of the respondents mentioned that there has been more appreciation for the purchasers of the organization. However, some of the respondents experienced competition between different departments concerning the amount of personal protective equipment. *"Every department scanned its own supplies. Some departments manipulated this process, to get more tock than other departments of the hospital. To be sure that their department is 'safe'"* (Respondent 3). In addition, there was more collaboration between hospitals at the start of the pandemic outbreak. This collaboration consisted mainly of knowledge sharing, but also distributing stocks. *"If a hospital had a hundred thousand gloves, and another hospital had nothing. The hospital had to show solidarity and loyalty, the gloves were redistributed between de organizations"(*Respondent 7). However, some respondents experienced more competition between different organizations. *"If you look very honestly if Hospital A has capacity for 1 or 2 weeks, they did not deliver to hospital B. Hospital B had to solve their own problems. The solidarity was there in theory, but really not in practice" (*respondent 3*).*

The respondents indicated that the Dutch government has encouraged collaboration among healthcare organizations. The government developed "het landelijk consortium hulpmiddelen (LCH)". The LCH is a Dutch consortium that is charged with the national purchase and distribution of medical aids and protective equipment during the corona crisis. In the beginning of the pandemic, LCH was only available for hospitals but now it is also available for other care organizations. Most of the respondents where very positive about the LCH, while some were negative, "*national consortium did not always deliver the products. Not reliable enough. Or the products did not meet our quality standards"* Respondent 12.

Besides the LCH, respondents mentioned another initiative that is responsible for distrusting products between hospitals within their region during the pandemic. ROAZ, also known as "regional overleg acute zorg", Respondent 6 mentioned *"There are 11 in the Netherlands, almost every province has its own ROAZ. They are responsible for ensuring that all healthcare organizations from a particular region cooperate in crises.* Respondent 9 mentioned *"Our hospital had to deliver our products to other hospitals. It was driven by ROAZ. They coordinated it. That is how we worked together".*

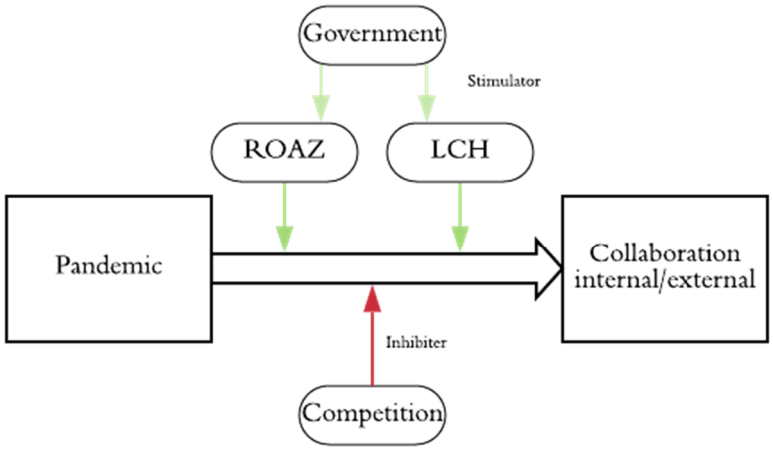


Figure 9; Different influences for internal and external collaboration

Summarizing, figure 9 gives an overview of the results concerning collaboration. The governmental organizations, ROAZ and LCH are stimulators for collaboration and competition is an ihibiter. Furthermore, it can be stated that there is more internal collaboration during a pandemic. Purchasers became more involved in different processes and workgroups. Furthermore, at the beginning of the pandemic, some organizations worked together while other organizations did not share this at all. Some respondents experienced more competition. Ultimately, the government has obligated to collaborate and to share stocks among healthcare organizations. It can therefore be said that the internal collaboration has increased, and the external collaboration is increased but more or less imposed by the government. So there is a certain degree of **support** fo proposition 3a.

P3b: During a pandemic, purchasers secure bottleneck items by renting products from internal departments or external organizations.

According to the literature, it is likely that hospitals rent bottleneck items internal or external during a pandemic. During the interviews, it became clear that none of the respondent rented products. Some hospitals temporary borrowed breathing equipment. Respondent 5 mentioned "*We did not rent. We managed to get by ourselves pretty well. With a lot of help from existing suppliers. Then you notice that good contacts in the market are very important."* Based on the information from the respondents proposition 3b must be **rejected.**

Importance of purchasing Criteria: - Total costs - Profit impact - P1: Patient value	high	**Leverage items** **Strategies:** - Targeted pricing strategies - Negotiation - Exploitation of full purchasing power - Order volume optimization	**Strategic items** **Strategies:** - Development of long-term relationships - Collaboration and innovation - Forecast demand - Detailed market research
		Non-critical items **Strategies:** - Product standardization - Process efficiency (automated purchasing)	**(temporary) Bottleneck items** **Strategies:** - Innovation and product substitution - Search for alternatives - Secure inventory **Expected strategies:** - P3: Innovation ▪ Alternative products ▪ Sterilizing and re-using products ▪ Second-hand products ▪ Converting appliances - P3a: Internal/external collaboration - P3b: Renting products
	low		
Supply risk Criteria: Supply, Logistic costs and complexity, and so on.	low → high		

Figure 10; Hospital purchasers are more innovative during a pandemic, but they do not rent their products.

6.4 Findings: Additional strategies and tactics used during the Covid-19 pandemic.

Next to the different strategies mentioned above, a lot of different strategies where mentioned by the respondents. This chapter will describe the strategies that are used by the purchasers during the Covid-19 pandemic.

Monitoring stocks

Almost all the respondents monitored their stocks more during the pandemic than before. In the hospital of respondent 2, they developed a dashboard which monitored the stock of personal protective equipment. The dashboard indicated for how many days the products where available. Other hospitals monitored the stocks on a more simplistic way. These hospitals kept stocks by using Excel as a dashboard. *"Continuously filling in the dashboard and take action on it. That is one of the most important things that happened around the bottleneck products"* (Respondent 13).

Daily consultation

In addition to monitoring stocks, almost every respondent mentioned daily consultation as a new strategy. During these consultations the stocks and the new developments within the hospital were discussed.

Collaborate with suppliers from a different industry (Product development)

During the interviews it became clear that the respondents collaborate more with new suppliers from a different industry. Respondent 13 collaborated more with a Dutch bed manufacturer. *"We collaborated with people from a completely different industry. Like, yes guys you are in the Netherlands, can you get raw materials from China and produce the products we need.. They had the device flown in from China to produce mouth masks for us."*

Searching for alternative products

Al the respondents mentioned that they purchased alternative products. Products with the same functionality but with lower quality standards, from another brand or supplier. *"We have worked with plastic jackets instead of insulation jackets. Surgical mouth masks have a certain reference, but we got them from a different manufacturer. But still have the same protection"* (Respondent 5). Some respondents did not find an alternative product with the same functionality but agreed to a product that is slightly different. "*Sometimes you just want*

something and you can fill it in via an alternative. But sometimes there is no alternative, and you have to accept that you can get a certain needle not in 4 cm but in 3 cm. (Respondent 9)

Shortening the purchasing process

To get the bottleneck products, the respondents mentioned that they shortened the usual purchasing process. It was important to get the products as quickly as possible. So the purchasing process was not adhered to. Respondent 10 mentioned *"We had to act in a few minutes otherwise the products where already gone. It was a completely different way of working. We did not use the usual purchasing process. The only purchasing process was to purchase the products as quickly as possible."*

Be aware of cowboys

Six different interviewees mentioned that they were approached by unreliable suppliers. These suppliers were only money oriented and did not have the quality standards. Most of the time, the purchasers had to paid in advance. So during a pandemic, a distinction must be made between these cowboys (unreliable suppliers) and the reliable suppliers. *"It became a bit like being on a market. You were suddenly approached by all kinds of people from all angles. I can help you, if you order me this I can deliver you guaranteed, but I must first receive 60% of the amount. The market was really strange and you also saw corruption especially in production groups such as face masks"*(Respondent 3).

Use older products

Two respondents mentioned that they used older products with older technology. Respondent 13 collaborated with the Dutch marines and used their breathing machines. *"The military has taken its own old equipment from the basements everywhere and left it with us. Huge Marines, with enormous muscle mass with all boxes of equipment came in the hospital"*

Longer use of products (Lower quality requirements)

During the interviews, it became clear that the quality requirements of certain products changed. The quality requirements of some products were reduced in order to purchase other product with the same functionality. It also became clear that some products could be used longer. Instead of 1 time, or for 3 hours, the products could be used 4 times, or for more hours. Respondent 2 mentioned *"Certain respiratory potentials were no longer available*

and we have started using them again. Or use them for a longer time. What is normally used for 24 hours, could be used longer.

Besides longer use of products and lower quality requirements, the personal protective equipment were sterilized by hospitals and external organizations in order to use the products again. *"The insulation jackets were of such good quality that we could re-sterilize them up to 3-4 times. After sterilization we could use them again."* (Respondent 5).

Price is not important

Almost all the respondents mentioned that price is not important during a pandemic to a certain extend. Respondent 4 indicated *"No price is not important. But at some point you will receive very crazy prices. Twenty times more than usual. There is a limit."* Respondent 13 *"the first offer we received was 70 times higher than usual There was an upper limit. But I did notice that price became less and less important. Availability was just key."* Respondent 2 mentioned "*Everything was possible with us. There were no limits. Very special."*

The respondents mentioned different strategies and activities used during the Covid-19 pandemic. These strategies and activities are grouped in the following: Inventory management, increase supply, be innovative and reduce demand.

(temporary) Bottleneck items	
Inventory management	**Increase supply**
- Monitoring stocks - Daily consultation - Shortening purchasing process - Secure inventory	- Search for a supplier from a different industry - Use alternative products - Sourcing priority: Price is not an important criteria - Awareness for cowboys
Innovation	**Reduce demand**
- Alternative products - Internal/External collaboration - Product development	- Sterilize and re-use products - Second-hand products - Converting appliances - Use older devices - Lower quality requirements - Use products longer

Figure 11; Different strategies and activities for bottleneck items during a pandemic

7. Final model: purchasing portfolio matrix which helps purchasers in hospitals to anticipate on a pandemic

<table>
<tr><td rowspan="2">Importance of purchasing
Criteria:
- Total costs
- Patient value
- Profit impact</td><td>high</td><td>Leverage items</td><td>Strategic items</td></tr>
<tr><td></td><td>Strategies:
- Targeted pricing strategies
- Negotiation
- Exploitation of full purchasing power
- Order volume optimization</td><td>Strategies:
- Development of long-term relationships
- Collaboration and innovation
- Forecast demand
- Detailed market research</td></tr>
<tr><td rowspan="2"></td><td rowspan="2">low</td><td>Non-critical items</td><td>(temporary) Bottleneck items</td></tr>
<tr><td>Strategies:
- Product standardization
- Process efficiency (automated purchasing)</td><td>Inventory management
- Monitoring stocks
- Daily consultation
- Shortening purchasing process
- Secure inventory

Increase supply
- Search for a supplier from a different industry
- Use alternative products
- Sourcing priority: Price is not an important criteria
- Awareness for cowboys

Innovation
- Alternative products
- Internal/External collaboration
- Product development

Reduce demand
- Sterilize and re-use products
- Second-hand products
- Converting appliances
- Use older devices
- Lower quality requirements
- Use products longer</td></tr>
<tr><td>Supply risk Criteria: Supply, Logistic costs and complexity, and so on.</td><td colspan="3">low → high</td></tr>
</table>

Figure 12; Purchasing portfolio matrix for hospitals during a pandemic

Figure 12 shows the updated Kraljic matrix which is applicable for hospitals. Based on the interviews, it became clear that patient value is a highly important purchasing criteria for hospital purchasers but the interpretation of this criteria differs among people and organizations.

Based on the interviews, non-critical items became (temporary) bottleneck items during a pandemic. Bottleneck items have a low-profit impact and a high supply risk. These products are only available from a few suppliers and have low strategic importance. The focus in this quadrant is on the security of inventories and backup plans. (Kraljic, 1983, p. 111) Next to the strategies from Kraljic, different strategies are mentioned by the interviewees. Figure 11 gives an overview of the purchasing portfolio matrix for hospitals during a pandemic with all the strategies and actions. The focus is on inventory management, increase supply, innovation and reduce demand. A larger version can be found in Appendix 5.

8. Discussion, implications, limitations and recommendations for further research

8.1 Purchasing portfolio matrix for hospitals found to be sufficient when the dimension strategic importance takes a criteria concerning patient value into account.

In this thesis, a new purchasing portfolio model for hospitals is developed, and new strategies for hospital purchasers during a pandemic were identified. The difference between the purchasing portfolio model from Kraljic and the new model developed in this research is the purchasing criteria patient value. Also defined and interpreted as quality, patient safety, impact on patient, patient friendliness and patients opinion.

The study from Medeiros (2018) is the only study who tried to classify health products within the Kraljic portfolio matrix. They classified twelve different products that are often used in hospitals. With a multiple-criteria approach they classified these products and the strategic purchasing strategy could be adjusted. They questioned whether the four quadrants and the two dimensions of Kraljic are sufficient and appropriate for healthcare purchasing within hospitals. Based on the information from Medeiros (2018) and this thesis, it can be stated that the four quadrants and the two dimensions of Kraljic are sufficient, but some redefining of the dimension is necessary. During the interviews it became clear that patient value is a criteria which is important to the hospital purchasers. Despite that the hospital purchasers recognize the criteria patient value, and told that it actually is a very important criteria, a lot of them interpreted the concept in a different way. Some named it the opinion of the patient, or patient friendliness. While other hospital purchasers called it quality or patients safety. So, overall it is clear that a criteria concerning the influence on patients must be added to the dimension of Kraljic, but it remains debatable and unclear how to define this criteria.

8.2 Different expected and unexpected purchasing strategies found to be beneficial for hospital purchasers during a pandemic

Furthermore, different strategies for hospitals purchasers during a pandemic are identified. Namely inventory management, increase supply, reduce demand and innovation. Within these strategies, different tactics and activities are identified namely, more collaboration, product development, sterilizing and re-using products, monitoring stocks, daily consultation, find suppliers from different industries, use alternative products, shortened purchasing process, awareness for cowboys, use older products, longer product use, lower the quality requirement and price is a less important purchasing criteria during a pandemic.

Based on the research from Bohmer (2020), a strategy they identified during the Covid-19 pandemic is learning and innovating in real time. During the Covid-19 pandemic, the demand for N95 masks increased rapidly. In response to this shortages, many hospitals developed alternative designs for these mask which where suitable for interacting with non-Covid-19 patients. Some hospitals sterilized the masks and reused them. Other hospitals turned to non-medical-grade masks, such as construction masks (Grimm, 2020, p. 5). Based on this information, the expectation was that hospitals were very innovative during the pandemic. During the interviews different respondents mentioned different innovative purchasing strategies. Indeed some respondents did develop alternative designs for masks and other hospitals sterilized masks and reused them. But there were also some special and striking strategies, for example, a hospital was able to obtain 6 more respirators because they converted existing anesthesia equipment. Or another hospital which collaborated with the Dutch marines and used their ‘older’ breathing machines. These are tactics that you not see often in literature. Besides, some hospital did change their purchasing process and their way of working. They monitored their inventory much more and on a new and innovative way. A hospital developed a dashboard which monitored the stock of personal protective equipment. The dashboard indicated for how many days the products where available. Other hospitals monitored the stocks on a more simplistic way. These hospitals kept stocks by using Excel as a dashboard. These activities where not found in literature. So, the expectation that hospital purchasers are more innovative during a pandemic correspond exactly with the results of this study since different innovative ideas came up during the interviews.

Another expectation which is based on the research from Bohmer (2020), is that there should be more collaboration between organizations and hospitals during a pandemic. Especially for pooling resources. In this thesis, it became clear that in the beginning of the pandemic there was no collaboration at all. Some respondents experienced the opposite, namely more competition. Interesting is that a respondent experienced competition between different departments of one hospital. Another respondent mentioned that there was in theory solidarity but not in practice. The expectation was that different hospitals pooled their resources, but in practice this turned out not to be voluntary. Only when the government got involved, there was more collaboration. The government developed the LCH and ROAZ, the different demand and inventory was balanced out. Especially the personal protective equipment was distributed over the different hospitals. Knowledge sharing was the only aspect of collaboration in the beginning. Within the hospitals, there was more collaboration between the purchasing departments and other departments. Despite people did work from home during the pandemic, respondents mentioned that there was more collaboration between them and others. So the expectation was more collaboration. In practice, there was no external collaboration at all except for knowledge sharing. Only when the government got involved, inventory was shared. Concerning internal collaboration, most of the time there was more collaboration between the purchase department and other department.

In the study from Grimm (2020), several US hospitals mentioned that they tried to obtain additional ventilators by renting them, getting through an affiliated facility, or by buying single-use emergency transport ventilators. So, at the beginning of the interviews the expectation was that the respondent should mention something about renting products from other organizations or hospital. But all the hospital purchasers mentioned that they did not rent anything from anyone. So this result does not meet the expectations.

Next to the expectations from literature, other strategies where identified in this study. These strategies, such as monitoring stocks, daily consultation, awareness for cowboys, lower quality requirements and less attention to price, were not expected and shows the added value of this research.

8.3 Theoretical and practical relevance of the research findings

This paper aims to clarify some questions regarding the development of a purchasing portfolio model for hospitals and the different strategies for hospital purchasers during a pandemic. Other researchers have suggested that the development of a purchasing portfolio model for hospitals requires more attention for further research (Gobbi, 2015; Medeiros, 2018; Nudurupati, 2015).

Theoretical relevance of the research findings

Findings of this thesis have academic relevance since it adds to the research of other scholars who research purchasing portfolios in general, purchasing portfolios for hospitals, and purchasing strategies during a pandemic. In this thesis, the findings provide a framework for hospital purchasing. Redefining the dimension strategic importance with a criteria concerning patient value is new to this field of research. Medeiros (2018) researched some of the aspects and suggest that the existing Kraljic matrix is not sufficient and some adjustments should be made but they did not make the adjustments by themselves. While the purchasing portfolio model from Kraljic has been widely researched in the past decades, redefining the strategic importance is a new addition.

Concerning the findings around the influence of a pandemic on the purchasing portfolio model. The idea that products will change rapidly from leverage and non-critical items to (temporary) bottleneck items is a new addition in this field. Also, the finding that during a pandemic items will not change to strategic items is new. Besides, the idea that products move rapidly from one category to another is a new finding since one is used to the idea that products will change from category in a slower way. This study has also shown more in detail different strategies which hospital purchasers used during the Covid-19 pandemic to successfully gain the bottleneck items (e.g. personal protective equipment). Different strategies such as inventory management, innovation, increase supply, reduce demand and their corresponding actions and activities for bottleneck items are new additions.

Practical relevance of the research findings

The findings of this research have different practical implications. As mentioned before, crisis occur every few years, but pandemics appear approximately every 30 to 40 years and last approximately 1 to 2 years (Samina, 2012, p 201). So, when a pandemic or crisis will happen again, the purchasing portfolio model can be used by the management of hospitals and the purchasers. They will have a guidance of how to react and anticipate on items that become rapidly (temporary) bottleneck items. Furthermore, this research shows which products will become bottleneck items during a crisis for example personal protective equipment. It is important that the management of hospitals have enough inventory for these products since it is likely that, when a pandemic or epidemic will happen again, these products will become bottleneck items again. Besides, this portfolio model shows different strategies and tactics which could be used for hospital purchasers but it can also be used by purchasers from another industry. When they experience items that (rapidly) change from non-critical items to bottleneck items, they can use the tactics from this purchasing portfolio model. Furthermore, the different strategies and tactics mentioned in this research can also be used when products are bottleneck items regardless of whether there is a pandemic or not.

8.4 Limitations and further research: This study could be repeated or extended by other scholars to validate its findings

In addition to the strength of this research is also naturally has its weaknesses. This study was carried out with a small research sample of 13 hospital purchasing operating in the Netherlands. This limits the external validity of the findings since they might not be the same in other geographic areas in the world. This study could be expanded to other countries to validate the findings.

Further, it would be interesting to find out, through for example a survey, how to define the criteria patient value. Since in it became clear that the hospital purchasers defined and interpreted patient value in different ways; quality, patient safety, impact on patient, patient friendliness and patients opinion. There seems to be something like patient value but the different interpretations of this criteria could mean that the criteria patient value is too vague. To use the developed purchasing portfolio model for hospitals in the best way, it is recommended to investigate how the criteria patient value can best be defined. It is also interesting whether the hospital purchasers will classify the products different in the

purchasing portfolio model when patient value (or another definition) is added as a part of the strategic importance dimension. Here, it would be interesting to see whether other purchasing strategies will be used.

It will also be interesting to find out what the influence is of the governmental organizations, like ROAZ and LCH, on the way of purchasing within hospital. During the pandemic, these organizations suddenly appeared. What are the influences of these organizations on the way of purchasing within hospitals and other healthcare organizations. Did they make purchasing easier, or just more limited?

Besides, it will also be very interesting to see how hospital purchasers from other countries experienced the Covid-19 pandemic. Did they experienced the same problems with the same products. Or are there some other products with high supply risk that where not mentioned in this research. How did they anticipated on these high supply risk products. Did they use the same strategies and tactics mentioned in this thesis. It will be interesting to investigate how hospital purchasers in other countries ensured that they got the bottleneck items.

Out of this research, the following questions are came forward and are interesting for further research:

- How should patient value, as a criteria of the new purchasing portfolio matrix for hospitals, be defined?
- Will hospital purchasers classify products different in the purchasing portfolio model when patient value (or another definition) is included?
- What are the influences of governmental organizations, which are created during the pandemic, on healthcare purchasing?
- How do/did hospital purchasers from other countries experienced the Covid-19 pandemic?
- Which strategies did these hospital purchasers, from other countries, use to ensure that they go mt the bottleneck items?

It would be interesting to see if future scholars pick the ideas up in further research.

References

Abdallah, A. B., Abdullah, M. Saleh, F. (2017). The effect of trust with suppliers on hospital supply chain performance: the mediating role of supplier intergration. *Benchmarking: an international journal, 24*(3), 694-715.

Altmann, J. (1974). Observational study of behavior: sampling methods. *Brill, 49*(3/4), 227-267.

Andersson, S., Servais, P. (2010). Combining industrial buyer and seller strategies for international supply and marketing management. *European business review, 22*(1), 64-81.

Arpan, L. M. a. P., D. (2003). Stormy weather: Testing stealing thunder as a crisis communication strategy to improve communication flow between organizations and journalists. *Public relations review, 29*, 291-308.

Baldwin, R. (2020a). *Economics in the time of COVID-19*. Retrieved from London:

Baldwin, R. (2020b). *Thinking ahead about the trade impact of COVID-19*. Retrieved from Geneva and CEPR:

Baldwin, R. T., E. (2020). *Thinking ahead about the trade impact of COVID-19*. Retrieved from Geneva and CEPR:

Barlett, J. G. (2006). Planning for avian influenza. *Ann Intern Med, 2006*(145), 141-144.

Barton, L. (1993). Crisis in Organizations: Managing and Communicating in the Heat of Chaos. *South-Western Publishing Co.* , 256.

Beauchamp, T. (2001). *Principles of Biomedical Ethics* (5th edn. ed.). Oxford: Oxford university press.

Bensaou, M. (1999). Portfolios of buyer-supplier relationships. *Sloan management review, 40*, 35-44.

Benson, L. (1990). Geographic Price Interdependence and the Extent of Economic Markets. *Economic Geography, 66*(1), 47-66. doi:10.2307/144105

Berardi, A., Perinelli, D. R., Merchant, H. A., Bisharat, L., Basheti, I. A., Bonacucina, G., . . . Palmieri, G. F. (2020). Hand sanitisers amid CoViD-19: A critical review of alcohol-based products on the market and formulation approaches to respond to increasing demand.

International Journal of Pharmaceutics, 584, 119431. doi:https://doi.org/10.1016/j.ijpharm.2020.119431

Bildsten, L. (2014). Buyer-supplier relationships in industrialized building. *Construction management and economics, 32*(1), 146-159.

Bohmer, R. P., G. R, Sadun. and Tsa, T. (2020). How hospitals can manage supply shortages as demand surges. *Harvard business review*. Retrieved from https://hbr.org/2020/04/how-hospitals-can-manage-supply-shortages-as-demand-surges

Bryman, A. (2012). Social research methods. In (4 ed.). Oxford: Oxford University Press.

Burns, L., R,. Lee, J. A. (2008). Hospital purchasing alliances: utilization, services and performance. *Operations reserach for health care, 33*(3), 203-2015.

C.R.Carter, M. M. J. (2004). The role of purchasing in corporate social responsibility: a structural equation analysis. *Journal of business logistics, 25*(1), 145-185.

Cain, A. (2020). Hospitals are stockpiling supplies amid fears a coronavirus-related mask shortage could endager healthcare providers. Retrieved from https://www.businessinsider.nl/coronavirus-outbreak-disruption-medical-supplies-respirator-masks-2020-2/

Canada, G. o. (2020). *COVID-19 pandemic guidance for the health care sector*. Retrieved from https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/health-professionals/covid-19-pandemic-guidance-health-care-sector.html#a4

Caniéls, M. C. J., Gelderman, C.J.,. (2005). Purchasing strategies in the Kraljic matrix: A power and dependence perspective. *Journal of Purchasing and Supply Management, 11*, 141-155.

Chen, D. P., S. Xia, W. (2013). Enhancing hospital supply chain performance: a relational view and empirical test. *Journal of operations management, 31*(6), 391-408.

Cheng, V. C., Lau, S. K., Woo, P. C., & Yuen, K. Y. (2007). Severe acute respiratory syndrome coronavirus as an agent of emerging and reemerging infection. *Clin Microbiol Rev, 20*(4), 660-694. doi:10.1128/cmr.00023-07

Company, B. (2017). *Frontline of healthcare*. Retrieved from https://app.shorthand.com/export/5c882d8b4d4c4fdfa68b0b8621070094/

Company, B. (2018). *Frontline of healthcare*. Retrieved from https://www.bain.com/contentassets/294dfad7b9f94a4bb7b3c75cd90cfa7c/bain_brief_front_line_of_healthcare_report_2018.pdf

Cutlip, S. M., Center, A.H. and Broom, G.M. (2000). Effective public relations. *Englewood Cliffs*.

Drake, P. R., Myung Lee, Hussain. (2013). the Lean and Agile Purchasing Portfolio Model. *Supply chain management: An international Journal, 18*(1), 3-20.

Dranove, D., Satterthwaite, M.A. (2000). The Industrial organization of health care markets. *Handbook of Health Economics*, : 1094–1139.

Fakhru 'l-Razi, A. S., A. (2003). A review of disaster and crisis. *Disaster prevention and management, 12*, 24-32.

Falagas, M., NV. Cholevas, AM. Kapaskelis, EK. Vouloumanou, A. Michalopoulos. et al. (2010). Epidemiological specs of 2009 H1N1 influenza:the accumulating experience from the Northern Hemisphere. *Eur J Clin Microbiol Infect Dis, 29*, 1327-1347.

Ferreira, L. M. D. F., A. Arantes, and A. A. Kharlamov. (2014). Development of a Purchasing Portfolio Model for the Construction Industry: An Empirical Study. *Production planning and control, 26*, 377-392.

Figueras, J. R., J. Jakubowski. E. (2005). Purchasing to improve health systems performance. *Europeon observatory on health systems and policies seriec*.

Flyvbjerg, B. (2006, April). Five misunderstandings about case-study research. Qualitative Inquiry, 12(2), 219-245.

Gelderman, C. A. J. V. W. (2003). Handling measurement issues and strategic directions in Kraljic's purchasing portfolio model. *Journal of Purchasing and Supply Management, 9*, 207-2016.

Ghanbarizadeh, A. H., Jafar. Razmi, Jafar. Bozorgi-Amiri, Ali. (2019). A purchasing portfolio model for the commercial construction industry: a case study in a mega mall. *Production Planning & Control, 30*(15), 1283-1304. doi:10.1080/09537287.2019.1612110

Gerring, J. (2004, May). What is a case study and what is it good for. 98(2), 341-354.

Gillon, R. (1994). Medical ethics: four principles plus attention to scope. *British Medical Journal of Management Studies, 309*.

Gobbi, C., Hsuan, J. (2015). Collaborative purchasing of complex technologies in healthcare: Implications for alignment strategies. . *International Journal of Operations and Production Management, 35*, 430-455.

Griffin. (2012). *Hospitals, What they are and how theyr work*. San Marcos, Texas: Michael Brown.

Griffin, M., Babin, B.J. and Attaway, J.S. (1991). An empirical investigation of the impact of negative public publicity on consumer attitutdes and intentions. *Advances in Consumer Research, 18*(334-341).

Grimm, C. (2020). *Hospital experiences repsonding to the COVID-19 pandemic: Results of a national pulse survey March 23-27*. Retrieved from https://oig.hhs.gov/oei/reports/oei-06-20-00300.pdf

Heida, J. E., B. Baeten, S. Gent. C. (2016). *Product market definition in hospital care*. Retrieved from The Hague:

Hepsing, F. H., Schiele, H.,. (2015). Purchasing strategy development: A multilevel review. *Journal of Purchasing and Supply Management, 21*, 138-150.

Huq Khandkar, S. (2009) Open coding. In: University of Calgar.

Ivanov, D. (2020). Predicting the impacts of epidemic outbreaks on global supply chains: A simulation-based analysis on the coronavirus outbreak

(COVID-19/SARS-CoV-2) case. *Transportation Research Part*.

Josep Figueras, R. R., Elke Jakubowski. (2005). *Purchasing to improve health system performance*. New York: Two Penn Plaza.

K.R.Yin. (2009). Case study research: Design and methods. *Thousand Oaks, 4*.

Kahn, J. (2020). Hospitals are running low on the most critical supply of all: Oxygen. *Fortune*. Retrieved from https://fortune.com/2020/04/02/coronavirus-treatment-hospitals-oxygen-supply-shortage-covid-19-patients/

Klaviyo. (2020). Key trends in brands. Retrieved from https://www.klaviyo.com/covid-19-daily-ecommerce-insights

Knight, L., Tu, Y. Preston, J. . (2014). Integrating skills profiling and purchasing portfolio management: an opportunity for building purchasing capability. *International journal of production economics, 147*, 271-283.

Koskinen, J. H., O. Kimppa, K. (2012). A Viewpoint for More Ethical Approach in Healthcare Information System Development and Procurement: The Four Principles *Communications in computer and information science, 313*. doi:10.1007/978-3-642-32850-3_1

Krabbe-Alkemade, Y. G. T., Lindeboom. M. (2017). Competition in the Dutch hospital sector: an analysis of health care volume and cost. *Eur J Health Econ, 18*, 139-153.

Kraljic, P. (1983). Purchasing must become supply management. *Harvard business review, 61*, 109-117.

KW. Tsang, P. E., CK. Liam, YS. Shim, WK. Lam. (2005). H5N1 influenza pandemic: contigency plans

Lancet, 2005, 533-534.

Last, J. M. e. (1983). *A dictionary of epidemiology*: IEA, oxford univ press.

Lebinger, O. (1997). The Crisis Manager: Facing Risk and Responsibility *(Lawrence Erlbaum Associates Publishers, Mahwah, NJ).* .

Lee, D. M., and Paul R. Drake. (2010). A Portfolio Model for Component Purchasing Strategy and the Case Study of Two South Korean Elevator

Manufacturers. *International Journal of Production research, 48*(22), 6651-6682.

Leistner, N. (2020). Forecasting the impact of COVID-19 on medical device trials. Retrieved from https://www.castoredc.com/blog/covid-19-impact-on-medical-device-trials/

Liu, Y. G., Y. (2012). Organizaitonal crisis management and public policy problem. *Second international conference on business computing and global informatization*, 380-383.

Lysons, K., Farrington, B. (2012). Purchasing and Supply Chain management. *Peason Education, Harlow*(8).

M.Kroneman, W. B., M.van den Berg, P.Groenewegen, J. de Jong, E. van Ginneken. (2016). Netherlands; Health system review. *Nivel, 18*(2).

Medeiros, M., Ferreira, L. (2018). Development of purchasing portfoliomodel: an empirical study in a Brazilian hospital. *Production planning and control*, 1-16.

Mitroff, I. (2000). Managing Crises before they happen. *New York: AMACON*.

Myriam Lingg, k. W., Luis Duran-Arenas. (2016). Effects of procurement practices on quality of medical device or service received: a qualitative study comparing countries. . *BMC health service research*

16(362).

Nudurupati, S. S., Bhattacharya, A., Lascelles, D., & Caton, N. . (2015). Strategic sourcing with multi-stakeholders through value co-creation: An evidence from global health care company. . *International Journal of Production Economics, , 166*, 248-257.

O'Brien, J. (2012). Category management in purchasing: A strategic approach to maximize business profitability. *Kogan Page London*.

OECD. (2020). *Tackling coronavirus (COVID-19): contributing to a global effort*. Retrieved from https://read.oecd-ilibrary.org/view/?ref=119_119689-ud5comtf84&title=Beyond_Containment:Health_systems_responses_to_COVID-19_in_the_OECD

Olsen, R. F., Ellram, L.M.,. (1997). A portfolio approach to supplier relationships. *Industrial Marketing Management, 26*, 101-113.

Organization, W. H. (2010). Emergencies preparedness, response. Retrieved from https://www.who.int/csr/disease/swineflu/frequently_asked_questions/pandemic/en/

Padhi, S. S., S. M. Wagner, and V. Aggarwal. (2012). Positioning of Commodities Using the Kraljic Portfolio Matrix. *Journal of Purchasing and Supply Management, 18*, 1-8.

Palinkas, L. A., Horwitz, S. M., Green, C. A., & Hoagwood, K. (2015). Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. Adm Policy and Ment Health, 42, 533-544.

Park, J. J., Shin, k. et al. (2010). An integrative framework for supplier relationship management. *Industrial management and data systems, 110*(4), 495-515.

Pathan, R. (2017). A report on perfectly competitive market. *Institute of business administration*.

Pauchant, T. C., Mitroff, I.I. and Lagadec, P. (1991). Toward a systemic crisis management strategy. Learning from the best examples in the US, Canada and France. *Industrial crisis quartely, 5*(3), 209-232.

Pettit, T., Fiksel, J., & Croxton, K. (2010). Ensuring Supply Chain Resilience: Development of a Conceptual Framework. *Journal of Business Logistics, 31*, 1-21. doi:10.1002/j.2158-1592.2010.tb00125.x

Raoul, N. M. A., N. Meessen, T. van der Werf. (2007). Pandemic influenza and hospital resources. *Emerging infectious diseases, 13*(11), 1714-1720.

Rijksoverheid. (2020). Aantal instellingen voor medisch specialistische zorg. *Ziekenhuiszorg.* Retrieved from https://www.volksgezondheidenzorg.info/onderwerp/ziekenhuiszorg/cijfers-context/aanbod#node-aantal-instellingen-voor-medisch-specialistische-zorg

Roosmalen, M. K., M. (2020). Dreigend tekort aan geneesmiddelen voor coronapatiënten op intensive care. *RTL Nieuws*. Retrieved from https://www.rtlnieuws.nl/nieuws/nederland/artikel/5072761/tekort-medicijnen-corona-ziekenhuis-ic

S.Jack, P. B. (2008). Qualitative case study methodology: Study design and implementation for novice researchers. *The qualitative report, 13*(4), 544-559.

Samina, M., Tabish, S.A., Mufti S. A. et al. (2012). Role of Hospital in Pandemic: Our experience. *JIMSA, 25*(3), 201-206.

Schneller, E. (2009). The value of group purchasing-2009. Meeting the needs for strategic savings. *Health Management*.

Segura, M., Maroto, C. (2017). A multiple criteria supplier segmentation using outranking and value function methods. *Expert systems with applications, 69*, 87-100.

Semeijn, G. D. J. S. (2018). Investigating cooperative purchasing performance- a survey of purchasing professionals in Dutch hospitals. *Central european review of economics and management, 2*, 133-153.

Sheshabalaya, T. (2010). The healthcare system in Netherlands. *Health Management, 5*(3-4).

Shrivastava, P., Mitroff, I., Miller D. and Miglani, A. (1988). Understanding industrial crises. *Journal of Management Studies, 25*, 285-303.

Silverman, E. (2020). *Hospials see shortages of a cheap steroid that one study says helsp Covid-19 patients*. Retrieved from https://www.statnews.com/2020/06/25/covid19-coronavirus-dexamethasone-shortages/

Taylor, S. P. (2017). What is innovation? A study of the definitions, academic models and applicability of innovation to an example of social housing in England. *Open Journal of Social Sciences, 5*, 128-146. Retrieved from https://doi.org/10.4236/jss.2017.511010

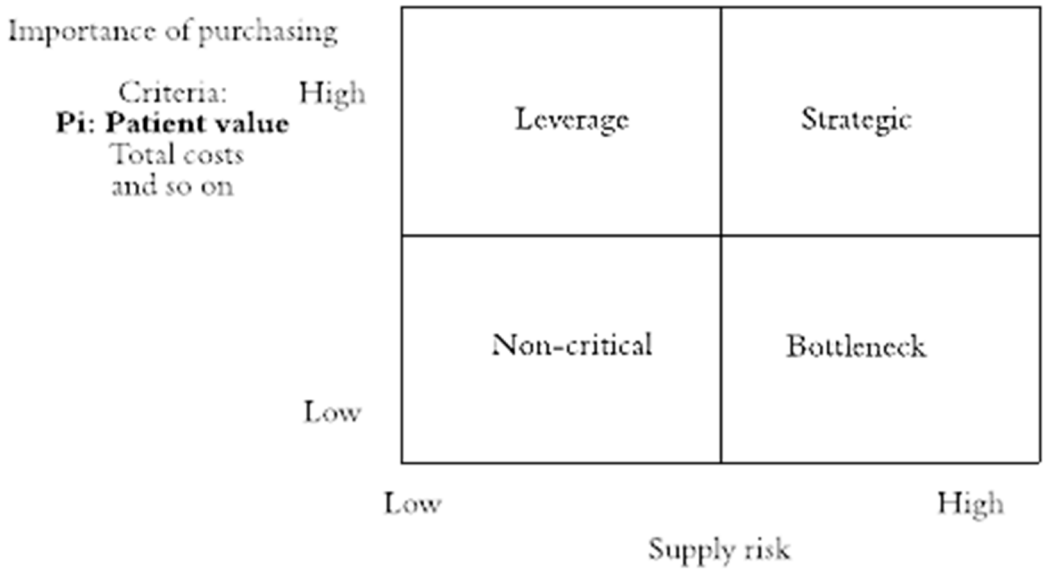
Tingru, C. P., L. (2014). Strategies of crisis management from contigent perspective. *Reserach Gate*, 1-16.

Van Weele, A. J. (2010). Purchasing and supply chain management: Analysis, strategy, planning and pactice. *Cengage Learning EMEA, Hampshire*(5).

Vaus, D. d. (2014). *Surveys in Social research* (5 ed.). Australia and New zealand: Routledge.

WHO. (2020). Basic protective measures agains the new coronavirus. Retrieved from https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public

Appendix 1: Conceptual purchasing portfolio model for hospitals



Appendix 2: Purchasing portfolio model with proposition

Importance of purchasing Criteria: - Total costs - Profit impact - P1: Patient value	high ↓ low	**Leverage items** **Strategies:** - Targeted pricing strategies - Negotiation - Exploitation of full purchasing power - Order volume optimization	**Strategic items** **Strategies:** - Development of long-term relationships - Collaboration and innovation - Forecast demand - Detailed market research
		Non-critical items **Strategies:** - Product standardization - Process efficiency (automated purchasing)	**(temporary) Bottleneck items** **Strategies:** - Innovation and product substitution - Search for alternatives - Secure inventory **Expected strategies:** - P3: Innovation - P3a: Internal/external collaboration - P3b: Renting products
Supply risk Criteria: Supply, Logistic costs and complexity, and so on.		low → high	

Appendix 3; Interview protocol

1. Instruction to the interviewer
   a. Opening
      I would like to thank you once again for being willing to participate in the interview aspect of my study. As I have mentioned to you before, my study seeks to understand how purchasers anticipate on the Covid-19 pandemic.

      Our interview today will last approximately 45 minutes during which I will be asking you about the influence of Covid-19 on the purchasing department. Before we begin the interview, do you have any questions? [discuss questions] If any questions arise at any point in this study, you can feel free to ask them at any time.
   b. Anonymity of the respondents
2. Explain the goal of the interview
3. Personal questions to be asked
   a. Personal information respondent
      - Can you describe your job?
      - How long do you work here?
4. What do you think is the main difference between private and public procurement?
      - What makes purchasing within a hospital different than industry?
      - Do you think that value for patient is a highly important factor when you buy products?
      - Do you think, value for patients, is (sometimes) more important dan profit impact?
5. How did/ or still does, the Coronavirus influence a hospital as a whole? And specific, the purchasing department?
   a. Can you give some examples?
   b. What where the main difficulties?
      - Which products where most difficult to purchase? Why these?
   c. What are the reasons for these difficulties?
6. Have you experienced any change in how to purchase product categories?
   a. Did you collaborate more with other hospitals?
   b. How did you purchase products with high supply risk?
7. Can you tell me some best practices?
   a. How anticipated you department on the pandemic?
   b. How did you anticipated on the pandemic? Behavioral changes?
   c. Did you collaborate more internal external?
8. Space for recording the comments
9. Thank respondent for time and effort
   a. Can I contact you again if any more questions exist?
   b. At the end of my research, do you want the results?

Appendix 4: Interview transcript

Not available.

Appendix 5: Final purchasing portfolio model for hospitals during a pandemic

Importance of purchasing Criteria: - Total costs - Patient value - Profit impact	high	**Leverage items**	**Strategic items**
		Strategies: - Targeted pricing strategies - Negotiation - Exploitation of full purchasing power - Order volume optimization	**Strategies:** - Development of long-term relationships - Collaboration and innovation - Forecast demand - Detailed market research
		Non-critical items	**(temporary) Bottleneck items**
		Strategies: - Product standardization - Process efficiency (automated purchasing)	**Inventory management** - Monitoring stocks - Daily consultation - Shortening purchasing process - Secure inventory **Innovation** - Alternative products - Internal/External collaboration - Product development	**Increase supply** - Search for a supplier from a different industry - Use alternative products - Sourcing priority: Price is not an important criteria - Awareness for cowboys **Reduce demand** - Sterilize and re-use products - Second-hand products - Converting appliances - Use older devices - Lower quality requirements - Use products longer
Supply risk Criteria: Supply, Logistic costs and complexity, and so on.	low	low	high