

# Dealing with Vendor Lock-in

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**ABSTRACT,** Vendor lock-in is the dependence of the customer to a certain extent on a supplier. It is a current topic in Dutch politics and particularly complex in public procurement of IT. In this paper a categorisation is developed to differentiate the underlying reasons for vendor lock-in. The categories are identified by conducting exploratory literature research. For each category a corrective approach is proposed to deal with a vendor lock-in situation. As an example, four cases of vendor lock-in situations at the IT purchasing department of the Dutch Tax and Customs administration (DTCA) are analysed and discussed. Purchasers can use the categorisation and corrective approaches proposed in this paper for evaluating and managing vendor lock-in.

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## **Keywords**

Vendor lock-in; Supplier dependence; Switching costs; Intellectual Property Rights; Incompatibility; Technology dependence; Public procurement; Dutch Tax and Customs administration (DTCA)

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*7<sup>th</sup> IBA Bachelor Thesis Conference*, July 1st, 2016, Enschede, The Netherlands.

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# 1. INTRODUCTION: VENDOR LOCK-IN

Vendor lock-in is the situation in which a customer perceives to be dependent to a certain extent on the products or services of a supplier (vendor). The customer is unable to switch to another supplier effectively. This can have several consequences like being over-reliant on one supplier and restricting other suppliers to compete which may result in high(er) costs.

Vendor lock-in may occur due to contractual agreements or intellectual property rights, but vendor lock-in may also be a perception of the buyer. Vendor lock-in does not always have to be a problem. You can perceive it as a problem, when you entered into a contract with too many restrictions or commitments, which give you the feeling of being 'locked-in' by the supplier.

Vendor lock-in frequently occurs in the area of IT. Characteristics of IT are a high degree of complexity and uncertainty due to the specificity of the purchases. This increases the probability of both the supplier and the purchaser to hold on to each other creating a vendor lock-in situation. Furthermore, IT purchases are mostly for a longer period of time and need intensive implementation. People need to be trained to work with the new IT which costs money and time. The training of people is an example of one of the investments that is required for IT purchases. It commits the organisation to this IT and makes it difficult to switch, creating a vendor lock-in situation.

Organisations may also become locked-in by their IT systems or suppliers because only their suppliers possess the exact knowledge about how their systems function. Therefore, for the acquisition of new functional additions or more user licences they have to stay with that supplier (Timmermans, 2013).

At the moment there is an ongoing discussion in the Dutch parliament about the idea that the Dutch government is depending too much on a few large dominant IT suppliers. This results in paying too much for the products and services. This is actually a situation of vendor lock-in (van Kooten et al., 2016).

As a consequence of this discussion in April 2015 the motion Oosenbrug and Gesthuizen has been accepted regarding the use of open standards, supplier dependency and open source software applications (Oosenbrug & Gesthuizen, 2015). It mainly advises the government to research which exit strategies can help the government become less dependent on IT-suppliers. Besides, it advises that when putting out to tender clear requirements are stated on dealing with open standards and open source software.

## 1.1 Public procurement

'Public administrations have been very much concerned since the 1980s about the need of avoiding vendor lock-in when procuring themselves with information technology (IT) infrastructure.' (Guijarro, 2007). The structure of purchasing in the public sector is different than in the private sector. Purchases in the public sector need to comply with regulations on tendering. Regulations on tendering in the Netherlands require public procurement to put out to tender every time they need to start a new contract, even if there is a vendor lock-in. The selected supplier for the tender may be the same supplier of the vendor lock-in so the tender is actually a waste of time and effort and the vendor lock-in continues. There may also be another supplier selected which can result in high switching costs.

Additionally, changes in political views on sourcing (e.g. insourcing vs outsourcing), the imposed policies determined by state policies and continuity of service within the departments

need to be taken into account. This all complicates the situations of vendor lock-in.

## 1.2 Aim of Research

Vendor lock-in is a current topic in Dutch politics and especially complex in the IT public procurement. The Dutch Tax and Customs administration (DTCA) has requested to research vendor lock-in at their IT purchasing department. This department is taken as an example for cases of vendor lock-in situations.

The aim of this research is to conduct exploratory research in order to identify different vendor lock-in situations and propose a way to deal with the vendor lock-in situations. Preventive actions could be taken in advance to avoid vendor lock-in. In this research the vendor lock-in situations are already there at the DTCA. Therefore, only corrective approaches will be proposed for when the buyer is already in a vendor lock-in situation.

## 2. METHODOLOGY

Exploratory literature research will be conducted in order to explore the phenomena of vendor lock-in and the key issues discussed in literature (Kothari, 2004). This literature research will be conducted on Google Scholar. Different scientific papers published in journals which either discuss vendor lock-in in general or one of the categories will be studied. The keywords used for general vendor lock-in papers can be found in Appendix A. The different papers will gradually give an identification of different reasons for vendor lock-in situations which will enable the development of a categorisation of vendor lock-in.

Subsequently, another literature research is conducted on Google scholar for each category. These keywords can be found in Appendix B. This literature research will support the description of each vendor lock-in category discussed in section 3. The categories developed earlier can be revised and adjusted in this step.

A corrective approach for each discussed category will be proposed in section 4. These corrective approaches are based on literature review. The keywords used can be found in Appendix C. For some categories, there may not be a corrective approach discussed in literature. Then the proposed approach is based on suggestions given during interviews with the DTCA or developed in this thesis.

In section 5 four vendor lock-in situations at the DTCA will be extensively analysed in order to provide some practical examples in public procurement and reflect on them with the developed categorisation. The vendor lock-in situations at the DTCA will be selected in consultation with the external supervisor at the DTCA and some of the interviewees of the purchasing department. The DTCA will select vendor lock-in cases which are significant for them, for which they are interested in receiving recommendations.

The situations at the DTCA will be analysed by conducting interviews with purchasers working with the supplier in that situation and by taking a look at the different contracts signed with the supplier. Besides, there will be interviews conducted with a policy expert, legal expert, category manager and economist at the department to obtain different perspectives on vendor lock-in. These analyses will help to fit the vendor lock-in situation at the DTCA into the developed categories in this paper. All the information provided will be given from the DTCA perspective which can lead to biased analyses.

After that the corrective approaches proposed in section 4 will help in formulating a recommendation for dealing with the vendor lock-in situations at the DTCA in section 6. The recommendations will be discussed with the DTCA in order to examine whether the given recommendations are reasonable and useful for them in practice.

### 3. DEVELOPING A CATEGORISATION

Exploratory literature review about vendor lock-in has been conducted. It was surprising that even though vendor lock-in seems to be a significant term in purchasing, there were almost no results on Google Scholar of papers with 'vendor lock-in' in the title. Most papers only mentioned vendor lock-in as lock-in in their papers. There has also been taken a look at the references of papers or at others papers which cited the found paper, which could again lead to other usable papers. The term supplier dependency or leveranciersafhankelijkheid in Dutch were also useful search terms. Table 1 below displays the 17 relevant papers that were identified in this exploratory literature research. Most papers about lock-in were related to technology and software, this correspond to the previous statement in this paper that vendor lock-in mainly occurs in the area of IT.

The papers displayed in table 1 mention several reasons for the occurrence of vendor lock-in which have been developed into categorisation that will be discussed in the following paragraphs of this section. The categories may be overlapping and interrelated.

#### 3.1 Monopoly

When the structure of the market is characterized as a monopoly, there is only a single supplier operating on this market. In the case of a monopoly, the purchaser can only buy from this single supplier. There is a lack of competition on this market, so the purchaser has no alternative suppliers to choose from (Kok, Theeuwes, & Janssens, 2003). This is a common cause for

vendor lock-in (Gelderman & Van Weele, 2003). The monopolistic position of the supplier becomes undesirable when the supplier starts to behave opportunistically.

There can be several reasons for the origin of a monopoly which can help in analysing the situation of the vendor lock-in. Monopolies can emerge because the government has given the exclusive rights to one specific organisation by law or the company owns the patents for a technology so no other company is able to use it (Gilbert & Newbery 1982; Heezen, 2012).

The distinction between technical and economic monopolies has not been frequently mentioned in literature, but is relevant to discuss. An economic monopoly is discussed above. It is the situation in which a single company is the only supplier on the market offering a specific product or service. While in the situation of a technical monopoly the supplier possess specific technical knowledge and abilities which other entrants do not possess so they have the monopolistic position because they are only able to acquire, integrate and use this technology.

Even though the category of monopoly is stated to be a common situation of vendor lock-in, it has not been widely discussed in literature as vendor lock-in. When discussing the subject monopoly in relation to vendor lock-in in literature, there is mostly spoken about *ex post* monopolistic power of the supplier in the vendor lock-in situation (Farrel, 1987; Farrell & Shapiro, 1986,1989; Londsdale, 1999). This *ex post* monopolistic power puts the supplier in an advantageous bargaining position and may be exploited by the supplier, for example by increasing prices and decreasing service quality. The supplier can behave opportunistically which may lead to inefficiencies.

#### 3.2 Intellectual Property Rights (IPR)

Intellectual Property Rights (IPR) serve as a means of protection by law for ideas and innovations created by people or organisations. Examples of IPR are trademarks, copyrights and patents. Especially in the IT sector there are innovations and new

**Table 1. Relevant papers about vendor lock-in**

	Monopoly	IPR	Technology dependence	Early adopter	Switching costs	Network	Incompatibility	Personal lock-in
Arthur, 1989				✓				
Cariels & Gelderman, 2005	✓	✓						
Draisbach, Widjaja, & Buxmann, 2013						✓		
Farrell, 1987					✓			
Farrell & Klemperer, 2006	✓			✓	✓	✓	✓	
Farrell & Shapiro, 1986					✓			
Farrell & Shapiro, 1989	✓				✓			
Gelderman & van Weele, 2003	✓	✓			✓			
Greenstein, 1997					✓	✓	✓	
Kok, Theeuwes & Janssens, 2003	✓				✓			
van Kooten et al., 2016			✓		✓		✓	✓
Liebowitz & Margolis, 1995			✓		✓			
Marinosa, 2001					✓		✓	
Perkins, 2003			✓	✓				
Witt, 1997				✓		✓		
Zauberman, 2003					✓			
Zhu & Zhou, 2012		✓					✓	

technologies for which a supplier has intellectual proprietary rights.

Patenting is probably the most commonly known form of intellectual property (Hettinger, 1989). Patents give the inventor the rights to exclude others from exploiting, meaning manufacturing, applying or selling the invention for a limited time period. The owner of a patent can grant licenses to others in order to give them the right to apply the invention claimed in the patent. In return for this license the owner of the patent receives a licensing fee on the patent and royalties of everything that is made using this invention (Knight, 2013).

Intellectual property right is a category of vendor lock-in (Zhu & Zhou, 2012). IPR creates strong barriers to entry into the market (Varian, 2001). The owner of a patent can restrict competitors by refusing to issue licenses (Siegel & Wright, 2007). This gives the owner of the patent market power. The buyer can become locked-in by a supplier if the supplier has the ownership of the IPR of the purchased product. The buyer cannot switch to another supplier because only that supplier owns the IPR of that product.

### 3.3 Technology dependence

The reason for a purchaser to be unable to switch to an alternative supplier may be technology dependence. The ability of an organisation to adopt to a newer technology depends on its level of experience with previous technology (Cohen & Levinthal, 1990). Prior experience with a certain technology makes the company used to work with that technology. It is impractical for the company to change to another technology of another supplier. The company becomes technologically dependent on the supplier. This causes a situation of vendor lock-in.

The lock-in due to technology dependence is created by path dependence which is discussed more often in literature (Liebowitz & Margolis, 1995; Arthur, 1989; van Kooten et al., 2016). The further an organisation is into a process, the harder it becomes for the organisation to switch from one path to another. Sufficient movement of an organisation down a specific path may ultimately lock-in one technology (Pierson, 2000). Path dependence creates potential inefficiency because there is a loss of capability of the organisation to adopt to better alternatives with possibly higher pay-offs (Sydow, Schreyögg, & Koch, 2009). Besides, path dependence makes an organisation inflexible, making it very hard to switch to another supplier.

Some public institutions decide to outsource all their IT to one supplier. This results in the supplier having even more knowledge and expertise about the application of IT in the organisation than the public institution itself, which makes the public institution technologically dependent on the supplier (van Kooten et al., 2016).

There is another explanation why companies may become technically dependent which is not mentioned in literature. A company can decide to build locally developed applications on the current product. The more locally developed applications are running on the product, the more technically dependent the buyer becomes on the product and therefore on the supplier. This creates a vendor lock-in situation.

### 3.4 Early adopter

Early adopters start applying a new innovation once the benefits of an innovation start becoming apparent. The adopter chooses to adopt the innovation early because at that moment the innovation is considered to be the best on the market. According to Rogers (1983), potential adopters observe early adopters for

information about the innovation. The information from the early adopter reduces the uncertainty of the innovation (Kalish, 1985). Early adopters have excess power if their preferences are taken into account by later adopters in the collective choice of what is adopted (Farrell & Klempner, 2006). However, early adopters are dealing with uncertainty (Perkins, 2003). They might commit to a standard that is bad for later adopters but will not be changed.

A technology may gain early lead in adoption which may become the dominant technology of potential adopters, with the other technologies becoming locked-out (Arthur, 1989). This early adoption of a technology may result in the consumer being 'locked-in' to the first technology causing a vendor lock-in situation (Jondet & Winn, 2008). The consumer cannot easily switch to a later technology on the market.

Early adoption creating a vendor lock-in situation does not have to be perceived as a problem. It is a problem, if the innovation that was early adopted, is not the best on the market but the consumer is locked-in by the innovation and therefore cannot switch. However, it is not a problem if this innovation is and remains the best on the market.

### 3.5 Switching costs

Switching costs can be defined as 'the onetime costs that customers associate with the process of switching from one provider to another' (Burnham, Frels, & Mahajan, 2003). Switching costs are a significant factor in deciding to terminate contracts and evaluating other suppliers. They are the main reason how companies get locked-in by one supplier, because switching to another supplier just costs too much (van Kooten et al., 2016; Gelderman & Van Weele, 2003; Greenstein, 1997; Liebowitz & Margolis, 1995).

In the IT sector companies are dealing especially with the switching costs in the area of training or learning when switching to another IT supplier. All the employees of a company need to be retrained in order to make use of the new IT product effectively, resulting in high switching costs. In the IT area switching costs can be so large that switching suppliers is virtually unthinkable (Varian, 2001). This creates a vendor lock-in situation. Vendor lock-in strengthens over time if parties invest in specialized equipment or unique processes which are specific to an organisation, causing high switching costs (Whitten & Wakefield, 2006). Furthermore, buyers may have made investments in assets that are incompatible with new product which also results in high switching costs (Heide & Weiss, 1995).

It may be complicated to calculate all switching costs. For example, employees who are already working with the same IT product for years and have gained a lot of experience may be reluctant to work with a new IT product. This reluctance of employees may influence their productivity which is difficult to express in numbers. Another example is the time it takes to switch to a new IT supplier which may even lead to a disruption in the business process which is difficult to include in the switching costs but is meaningful. Especially in public procurement disruption is unfavourable since continuity in services is significant and to prone public opinion.

An important subject which needs to be mentioned for this category are the hidden IT costs. Most companies may not realize how much they have spent on an IT purchase until the transition is complete, when the company should either reintegrate their activities or would like to switch to a new supplier (Barthelemy, 2001). Companies may underestimate the setup costs, like redeployment costs, relocation costs or companies may underestimate management costs (Earl, 1996). The hidden IT

costs may be so high that the amount of money already invested in the current IT supplier may not outweigh the switching costs to another supplier and therefore create a vendor lock-in situation.

### 3.6 Network

The network effect of a product is the effect that occurs when the demand of a product increases with the number of other users of the product or with the number of complementary goods and services of that product (Gilbert & Katz, 2001). This implies that if no one adopts this product, the product has no value and no one wants to use it. If there are enough adopters of the product, the product becomes valuable. When even more people start adopting the product, it becomes even more valuable (Varian, 2001). The more users there are, the more perceived value there is for the consumer to also start using the product (Draisbach, Widjaja, & Buxmann, 2013).

Network effects may contribute to a vendor lock-in. The more consumers start using a certain product, the more they become 'locked-in' by the supplier of this product. This lock-in raises barriers to entry for radical alternatives that are not part of the dominant cluster (Perkins, 2003). Consumers themselves can also become reluctant to change vendor or networks due to the strong positive 'network effects' associated with using a product within a particular network (Jondet & Winn, 2008).

Lock-in caused by network effects is mainly discussed from the perspective of customers in literature. Companies are put under pressure by their employees who are the users of products with network effects, to also acquire this product and become locked-in. This can be beneficial since the users are already accustomed and experienced with the use of the product. However, the product may also be much more costly and less effective than alternatives with fewer users.

### 3.7 Incompatibility

Suppliers of technologies can create vendor lock-in by designing a system which is incompatible with systems developed by other vendors (Zhu & Zhou, 2012). Through technological incompatibility suppliers limit competition in complement good markets. If buyers purchase a product that is technological incompatible with products of other suppliers, the buyer cannot easily switch to another supplier without incurring high endogenous switching costs. The switching costs for the buyer are the price of any durable parts that needed to be replaced when purchasing a complement of a different supplier (Marinoso, 2001). This results in a situation of vendor lock-in.

Incompatibility may also be caused by the buyer because the IT of an organisation needs to be aligned to the service or product of the supplier. The organisation will conduct several customisations or configurations for this alignment in order to achieve optimal performance. However, these changes to the service or product of the supplier may increase incompatibility because the standard is altered (Londsdale, 1999). The more customisations and changes to the standard are conducted, the more incompatible the service or product becomes and the more dependent the buyer becomes on the product of the supplier creating a vendor lock-in (van Kooten et al., 2016). The lock-in of incompatibility can become stronger if the customisations within an organisation are executed by the supplier who in that situation may claim the IPR on these customisations.

### 3.8 Personal lock-in

Buyers can have specific preferences or take certain decisions which lead them to becoming locked-in by one supplier and making it hard to switch. This can be categorised as 'personal lock-in'. The buyer is personally creating the lock-in with the supplier. This category is not explicitly discussed in literature, but it is important to mention.

When a company acquires a product of a supplier, the company may design the entire environment around this product. The process of the company becomes intertwined with the product of the supplier creating a dependency (van Kooten et al., 2016). For example, the company decides to make locally developed applications to run on the product. This was also explained in the category of technology dependence. Another example: the company can decide to conduct the control of the product themselves instead of outsourcing it to third parties. The broader the company sets up the environment around that product of the supplier, the more dependent the company becomes on the supplier. In this case the company causes the vendor lock-in themselves.

Companies can create incompatibility by the configurations and customisations to the standards that they execute themselves, as mentioned in the category of incompatibility. Due to decisions and actions taken by the company for these customisations the vendor lock-in is strengthened.

## 4. DEALING WITH VENDOR LOCK-IN CATEGORIES

Vendor lock-in situations can be positioned in the quadrant of 'strategic' and 'bottleneck' in the Kraljic portfolio matrix (Kraljic, 1983; Gelderman & Van Weele, 2003). In these two quadrants the supply risk high which may be caused by the dependence on one source of supply, as in a vendor lock-in situation. The purchasing strategy for being in the strategic quadrant is to develop a performance-based partnership with the supplier. For the bottleneck quadrant the purchasing strategy is securing continuity of supply (Gelderman & Weele, 2002; Weele, 2010).

Beforehand, it is important to note that in both quadrants the relationship with the supplier can be pleasant. The supplier can be charging reasonable prices and agreeing on reasonable terms. If the situation is favourable, the purchaser can decide to stay in the quadrant and follow the strategies mentioned above. However, the situation with the supplier can also be unfavourable, because the supplier is exploiting his position of being the only one supplier to the company. In this case the purchaser should try to move to the quadrant with a lower supply risk, from strategic to leverage or from bottleneck to routine (non-critical). The purchaser can attempt to reduce the supply risk by collaborating with the internal customer to standardise the demanded product. By making the product less complex and standardised, more possible suppliers could offer the product and therefore reducing the dependency on one supplier (Gelderman & Van Weele, 2002). Another approach is the search for an alternative supplier (Caniels & Gelderman, 2005). The purchaser can develop another source of supply for the product, which can be in-house or with another supplier.

This a common approach that can be used for the situation of vendor lock-in. In this section for each category a corrective approach for vendor lock-in situations will be proposed.

## 4.1 Monopoly

First of all, it is important to evaluate whether the buyer is a large customer for the monopolistic supplier by taking a look at what percentage of the supplier's sales the buyer represents. This indicates how dependent the supplier is on the buyer which influences the bargaining position of the buyer against the monopolistic supplier. It can also be significant to estimate the costs for the supplier if they would lose the buyer as a customer (Yadav, 2016). If the buyer is only a very small customer for the supplier, the buyer does not have much power to stand up against the supplier.

An approach for the buyer against the monopolistic supplier is to form a 'procurement consortium'. This implies that the buyer unites together with other buyers having similar requirements. One buyer purchases on behalf of all the buyers. This gives the buyers in the consortium a greater bargaining power (Chartered Institute of Purchasing and Supply, 2013).

The buyer may also establish a strategic partnership with the supplier which strengthens the relationship. This partnership may involve cooperation between the supplier and buyer in which the supplier can be involved in the process improvement, technological advancement or inventory management of the buyer. The buyer leverages the experience of the supplier and obtains value for the company. Both parties benefit in this cooperation (INSINC Inkoopadviesbureau, 2016). In the public sector a long-term partnership with a company in the private sector is referred to as public private partnership (PPP) (Hodge & Greve, 2007; Zitron, 2006).

## 4.2 Intellectual Property Rights (IPR)

Vendor lock-in due to IPR occurs because the supplier has the ownership of the IPR of a product which creates a barrier for competitors and makes it hard for buyers to switch. The IPR should not restrict competitors but make it possible for competitors and customers to use the innovation protected by IPR and therefore enabling customers to switch.

Once the buyer is already in a vendor lock-in situation because the supplier owns the IPR of the product, a corrective approach should be applied. An approach which could be used is IPR assignment. IPR assignment is the permanent transfer of ownership of IPR from one party to another without any conditions on the time period or usage (European IPR Helpdesk, 2013). Licenses only give limited permission for usage of IPR under certain conditions for a limited time period (Stim, 2016). IPR assignment makes the buyer the owner of the IPR, having almost the same rights as the supplier except the rights of exploitation of the product on the general market. It removes the cause for the vendor lock-in and therefore solving the vendor lock-in situation due to IPR. The buyer should negotiate with the supplier about this IPR assignment and a written form must be made and signed by all parties. It demands a lot of persuasiveness of the buyer to convince the supplier to transfer the IPR because the supplier loses all control over the IPR. Furthermore, for the assignment of IPR the buyer needs to pay a large amount of money to the supplier.

## 4.3 Technology dependence

Technology dependence can occur because of prior experience, path dependence, sourcing all IT at one supplier and construction of locally developed applications on the product of the supplier. Corrective approaches for this category are not discussed in literature and are therefore based on own suggestions.

A corrective approach for the prior experience and path dependence could be to evaluate other technologies to which the company could possibly switch. In the evaluation all the costs of regaining the same level of experience with a new technology and starting a new path with a new technology should be considered. It will take a lot of time, effort and costs to try to switch to another technology and start all over again. The company should carefully deliberate how undesirable the current situation is before starting to make a switch to another technology.

When technology dependence is created by sourcing all IT at one supplier, the company should search for other sources of supply for some part of the IT. The purchaser should distribute the IT at several suppliers, so the purchaser is not dependent on only one supplier.

Technology dependence due to the construction of locally developed applications on the product of the supplier can be decreased by dismantling the locally developed applications. By taking away the cause for the technology dependence, the locally developed applications on the product, the vendor lock-in decreases. The applications can be either transferred to a general environment or could be made independent of the platform. This dismantling can be part of the exit strategy of a company from a vendor lock-in situation.

## 4.4 Early adopter

The buyer decides to become an early adopter because at that moment in time that product or service seems to be the best fit for reaching the buyers goals on the market. The buyer is already an early adopter in this situation so only corrective action can be taken for vendor lock-in due to early adoption.

It is important that the buyer continues to regularly conduct market research in order to evaluate if the adopted product or service of the supplier is still the best on the market. If the results of the market research show that the product or service offered by the supplier is not the best anymore, the buyer can put pressure on the supplier to improve or threaten to switch.

## 4.5 Switching costs

The main reason for vendor lock-in are the costs for switching to another supplier. Farrell (1987) states that in order to decrease switching costs a company should demand product standardization or compatibility among suppliers. However, these and other approaches discussed in literature are more preventive. It is difficult and almost impossible to change the volume of the switching costs once being in a vendor lock-in situation.

A company can attempt to spread the switching costs over the long-term in order to reduce the impact of the costs on the organisation. The company can spread the costs by gradually switching to another supplier. For instance, the company can start with switching only one part of the organisation to the new products of the supplier and then later in time switch other parts of the organisation.

## 4.6 Network

Vendor lock-in can be created due to network effects. If a product is already used by many users widely, this network effect may put pressure on a company to acquire the product and therefore become locked-in.

In literature there is no corrective action for vendor lock-in due to network discussed. A company should first decide if the company wants to consider not to make use of the product with many users. The switch to an alternative product with only a few users is difficult. Additionally, the users may be used to the current product.

However, if a company decides to change to an alternative product, there should be cooperation with all the users of the current product. The users are the drivers behind the network effect of the product. The company should convince the users that there is a need for a switch to be made from the current product. For instance, because of high costs or inefficiency. Once the users are convinced and committed to switch to an alternative, they can help the company in evaluating alternatives. The users can communicate their needs, which features they did like and what they missed in the previous product. This will all help the company in effectively arriving at an alternative. The cooperation with the users should create support for the alternative.

## 4.7 Incompatibility

Incompatibility between different systems of different suppliers can cause a vendor lock-in. The opposite of incompatibility is compatibility and interoperability between systems. Open standards are presented by literature to be the main solution in order to guarantee interoperability and the possibility to choose among different products (West, 2004). Open standards are defined to be 'standard interfaces (in general requirements) of IT systems and services' (Cerri & Fuggetta, 2007). They allow systems developed by different technology providers to interoperate, therefore making it possible to have a variety of interchangeable and interoperable products developed by different companies. This reduces the supplier dependency and therefore the vendor lock-in (Baarsma, 2004).

Open standards are stated to be especially important in the public sector. Citizens should not be required to purchase systems from specific suppliers in order to access public services (Ghosh, 2005). Public procurement can execute significant influence on technology providers that do not support open standards. The government plays an important role as a customer in defining the standard (Swann, 2000).

A corrective approach for incompatibility would be to gradually apply open standards in the current environment of the product or service. The additional applications that are built in relation to or on top of the product of a supplier creating the vendor lock-in should be altered step by step into open standard applications or if needed by using open standard application interfaces. In this way you can create independency in your own environment, even though the interfaces between the applications in your environment and the product of the supplier are still incompatible. The introduction of open standards will eventually lead to all your applications having open standards so you can even replace the product of the vendor by another open standard product or service. Besides, by starting to apply open standards within your environment pressure is already put upon the supplier. The migration costs for transferring from closed to open standards are often high, but keeping the current closed standard can also incur high costs. The long-term benefits of open standards are important to consider (Baarsma, 2004).

## 4.8 Personal lock-in

Personal lock-in is created due to decisions made and actions taken by the company itself to design the entire environment

around the product of the supplier. To deal with this personal lock-in the company should firstly stop designing the organisation even more around the product. When the organisation stops to build even more on the product of the supplier, the organisation can at least not expand the vendor lock-in situation.

Furthermore, a company should try to gradually disconnect the organisation from the product of the supplier. This is a process which needs to be conducted step wise and takes time. For example, you can start by outsourcing the support of the product (if possible) to third parties instead of conducting the support in-house or by applying open standards like explained in the previous paragraph. In this way the dependency on the product of the supplier reduces and the vendor lock-in diminishes.

## 5. VENDOR LOCK-IN SITUATIONS AT THE DTCA

A few vendor lock-in situations at the Dutch Tax and Customs administration (DTCA) will be discussed. An extensive analysis of the situations will be conducted. The situations at the DTCA will be reflected in one or more of the categories identified in the previous section.

### 5.1 SAP

The DTCA signed their initial contract with SAP in 1995. The contract was signed for the SAP Business Suite with the purpose of enterprise resource planning (ERP). Two important aspects in this contract should be highlighted. The first one is the requirement of SAP for the DTCA to set up their own competence centre which would form a permanent centre of SAP expertise with highly trained employees on SAP. They would ensure proper implementation of SAP within the organisation. The second one is that at the end of every year SAP will calculate the usage level and intensity of the usage of the DTCA which will determine how much the DTCA needs to pay for the next year.

The SAP Business Suite consists of several functional applications, or so called business-modules. When acquiring the SAP Business Suite one license for each module is obtained which can be extended. This enables the business owner of the SAP Business Suite to easily start using one of the applications and design the application to their own demands. When the DTCA would start using one of the applications, the usage amount calculated at the end of the year increases and so they pay for the extra module used. SAP gives the opportunity to configure their application to your own demands.

In 1995 the DTCA started the training of approximately 100 employees which would set up the competence centre for SAP at the DTCA. The DTCA started with the financial management solutions, one of the modules offered in the SAP Business Suite. In order to use this financial management application, all the employees of the financial department needed to be trained for this system. In the subsequent years SAP applications were introduced for human resource management, facilities management, supplier relationship management and currently also for customer relationship management. The usage of SAP at the DTCA was increasing rapidly. As a consequence, more and more people of all those departments were trained to use SAP and this results in a few thousand employees being trained to work with SAP only.

The underlying reason for starting to apply SAP in different departments is that once the DTCA started using SAP it seemed logical to apply SAP each time a new system was demanded,

since they already possess the knowledge and skills. Besides, the acquired SAP Business Suite already consisted of all these modules so the DTCA just needed to customize the design of the application to their process and start using it. SAP provides the DTCA with a basic and standard solution and then the DTCA configures it to their own specific needs.

At the end of the first few years the DTCA was surprised by the sum they had to pay extra for the usage amount and especially for the usage of new licenses due to application of new modules. Therefore, the DTCA decided to start conducting their own license audits monthly in order to monitor their usage and steer the usage.

When starting to apply a new product, like the SAP business suite, the current business process of the DTCA needed to be mapped to the product, so the business process need to be adjusted to the new product. The adjustment incurred high costs, especially for the training of thousands of employees for the usage of this new product. The consequence was that the business process of the DTCA got more and more intertwined with the SAP product. The DTCA process became increasingly dependent on SAP which results in a vendor lock-in situation. This illustrates the category of 'incompatibility'. The system of the DTCA becomes more and more intertwined with the system of SAP, which causes the system to be incompatible with systems of other suppliers. Another reason why there is incompatibility is that the DTCA configures the standard of SAP to their own specific needs. This standard is incompatible with other standards offered by other suppliers. It appears to be desirable to adjust the design of the SAP product to the specific needs of the DTCA, but actually it results in their process becoming more and more dependent on the SAP product and difficult to switch since they changed the entire standard.

The situation of SAP also fits into the category of 'switching costs'. If the DTCA would switch to another supplier than SAP it would not only cost the millions of the initial investment and implementation costs, but there are much higher costs related. These costs are normally called the hidden IT costs. Since the SAP product is used in different departments, about five thousand people of the DTCA are trained to work with SAP products for about 15 to 20 years, so they gained a lot of experience. They are as such used to work with SAP that they do not know anything else. Besides, there are about 100 people in the competence centre which are highly trained for SAP. This reinforces the vendor lock-in in this situation. The retraining of all those employees to another system, regaining all this experience and knowledge, will cost millions. The initial investment is little compared to all the switching costs. The initial investment is approximately only 1/10th part of the total cost of ownership. Furthermore, it takes time for the employees to work effectively with the new system. This may lead to a disruption in the business process of the DTCA, while continuity is significant to be guaranteed in such a public institution.

Just now there has been a decision made by the board of directors that the DTCA needs to put the ERP out to tender. However, taking into account the issues previously mentioned, is it cost-effective to switch?

## 5.2 Oracle

In 2005 the DTCA called for tenders for the support of the tax collection process. The product of SPL, which was later taken over by Oracle, suited best according to the requirements of the DTCA tender. This product was already used in the energy sector, where also collection of money from clients takes place. The DTCA thought the system could also be used for the

collection of money within the DTCA. In the initial contract agreements have been made in such a way that all intellectual property rights are owned by the supplier and not by the DTCA.

The DTCA thought they had purchased a product which could support the collection process of taxes and would only need slight customisation or configuration. However, at the moment the DTCA started to run the new system for their collection process, there turned out to be much more customisation and configurations necessary. Therefore, the DTCA needed to perform considerable customisation and many configurations to the standard product in order to make it operate according to the needs of the DTCA.

The more the DTCA started integrating the product into the IT environment, the more the supporting system of the collection process became an essential supporting program for the DTCA in their daily business process. By becoming more and more dependent on the product of this supplier, a vendor lock-in situation was created.

At first, there is a vendor lock because of IPR. As mentioned previously, all the intellectual property rights of the product are owned by Oracle. Therefore, all the custom fit and configurations made by the DTCA are intellectual property of Oracle. The DTCA dictates and teaches Oracle how the processes need to be made, but the customisation remains property of the supplier Oracle. According to the contract, the DTCA only holds limited easements.

The situation also falls into the category of 'monopoly'. In the beginning in 2005 Oracle did not have a monopolistic position in the market. The DTCA has made many alterations to the standard product and they invested about €200 million into the development of the product towards their specific needs for their collection process (Stokmans, 2014). These configurations have developed Oracle into being the single supplier on the market now who can offer and facilitate this customised product and the maintenance on this product. There are no other suppliers offering this customised product and the maintenance on the market to which the DTCA can switch. Besides, by making all these configurations the DTCA caused themselves to being technically dependent on Oracle, which was also identified as a category of vendor lock-in.

This all illustrates the category of personal lock-in. The DTCA took actions which caused a vendor lock-in situation. By making all the configurations to the standard product of Oracle, the DTCA became technologically dependent on Oracle.

There has also been a political contribution to this vendor lock-in due to political pressures on the DTCA. Firstly, if an old system does not suffice anymore, extra investments in the implementation are made, pressured by political attention. Secondly, every year new tax regulations are instituted by the government and need to be implemented in the tax collection system. This causes a point of no return early in the implementation process as the old system does not have this alterations by the new legislation. This also fits into the category of 'personal lock-in'.

The DTCA cannot switch to another supplier since Oracle has now developed into being the single supplier offering this customised product and the maintenance on this product on the market. Nevertheless, there are suppliers who could also offer this customised product. However, taking into consideration the switching costs and comparing these costs with the amount of money already invested into this environment by the DTCA, these costs are out of proportion.

Another important category which applies in this situation is 'incompatibility'. All the configurations made are specifically



designed for the DTCA, by which the process of the DTCA was leading. Due to the process of the DTCA being the driver for the alterations, the process is incompatible with the rest of the world. It is functionally incompatible. The DTCA went from a standard product to a custom fit product. The intention of the DTCA was to have 20% of the product custom fit and remain the other 80% standard product. Eventually it was the opposite, 80% of the product was custom fit and 20% standard.

### 5.3 Genesys

Genesys is a company offering call centre technology. The DTCA initially acquired the call centre platform of Genesys for their tax telephone. They chose Genesys since they were the only supplier in the market offering such a framework.

The Genesys platform is excellent. It is the installed base of the DTCA on which the DTCA puts different applications which are generally not from Genesys. These standard applications for Genesys need to be reconfigured in order to integrate with the Genesys platform of the DTCA. The DTCA hires specialists who can implement these configurations. When the DTCA puts out to tender an application, the most important demand is that it fits with their installed base of Genesys or that it can be configured. In practice large suppliers on the market can fit with other suppliers like Genesys.

The applications and installed base of Genesys are acquired by the DTCA. In case the DTCA would switch to another supplier, this can all be taken over. However, only the connections between all those different applications and the installed base need to be changed. These are all loose components which can be transferred by specialists. Therefore, there is no complete incompatibility.

The DTCA decided to carry out the functional control and maintenance themselves and they contracted 3<sup>rd</sup> line support. The DTCA requires Genesys to be transparent about support pricing for 3<sup>rd</sup> parties support. All 3<sup>rd</sup> parties shall be quoted equally. The DTCA hires CCI (call centre international) specialists for support. These CCI specialists can be acquired on the market but they are really rare.

The switching costs to another supplier than Genesys are very high. There is a considerable amount of applications built on the Genesys platform. These applications all need to be transferred which takes a lot of time and money because specialists need to be hired. Moreover, the switch to another supplier may lead to a temporary disruption of the call centre platform of the DTCA which causes a disruption in the continuity which is unacceptable from a political point of view.

This situation also fits into the category of 'monopoly'. Genesys has a monopolistic position. The DTCA bought this platform because at that time this platform was the best on the market. The monopolistic position causes the vendor lock-in. In order to manage this monopolistic position and prevent Genesys to exert power, the DTCA collaborates with other large companies like Rabobank and Achmea. This collaboration turns the DTCA and the other companies into being one big customer for Genesys which gives them negotiating power over Genesys. If they want to achieve something together, Genesys is willing to execute it.

Another category in which the situation fits is 'technology dependence'. The DTCA has become technologically dependent on the Genesys platform which makes it really hard to switch to another. Every year analyses of the market are conducted and current analyses of the market have shown that Genesys is still leading in the market of call centre technology (Gartner Names Genesys a Leader in 2015 Magic Quadrant for Contact Center

Infrastructure, 2015). Therefore, being technologically dependent may not necessarily be negative in this situation.

The DTCA may be seen as an early adopter in this situation. At the moment the Genesys platform was purchased, the platform was the best one in the market having such characteristics. However, like mentioned before, the platform is excellent and Genesys is still leading in the market. Even though the DTCA was an early adopter in this situation, they made the right decision to adopt this platform early.

### 5.4 Microsoft

Microsoft offers a wide range of products, but the focus for this research will be only on Microsoft desktop products. The DTCA works with Microsoft since the nineties. Microsoft is different than the other situations since the vendor lock-in is mainly driven by consumers. Microsoft has been offering free packages or very cheap packages to private users and especially students. Students and private users get very used to the Microsoft desktop products and they regard it as the standard way of working. Since people are accustomed to using Microsoft desktop in private, they pressure companies into also working with Microsoft desktop. Since so many companies already work with Microsoft, and being able to open documents from other companies is essential, organisations feel a strong need to consume the product. This is valuable for the organisation as well because the employees are already experienced with the use of the program. The employees do not require training which saves costs and time.

The last enterprise agreement of the DTCA with Microsoft was contracted in 2010 lasting till 2014. This contract was not extended by the DTCA, since they still have the rights to use the latest version of 2013 which is sufficient for the years to come. At the moment the DTCA is still using the version of 2010. It does not make sense for the DTCA to enter into a new contract, which means paying for versions that will not be used during this new contract term. This was a logical but at the same time bold decision by the DTCA which took Microsoft by surprise. Due to not having a contract with Microsoft anymore, there are no direct switching costs to be paid.

The situation with Microsoft fits into the category of 'personal lock-in'. On the Microsoft desktop there are approximately 750 locally developed applications of the DTCA running. These locally developed applications are made for specific products of the Microsoft desktop and they may not work if the DTCA would switch. This shows how the DTCA locked-in themselves by attaching all these locally developed applications to the Microsoft desktop.

The situation can also be fitted in the category of 'network'. The more consumers started using Microsoft in private, the more significant Microsoft desktop became for organisations to use. Organisations are pressured by both old and new employees which are experienced in using the Microsoft desktop to buy Microsoft desktop.

Another category in which the situation fits to some extent is 'incompatibility'. Even though an open source variant such as Open Office is available, there is always the nuisance of incompatibility. When opening a Word or Excel in Open Office macros or style elements may not be available and therefore rendered useless. This nuisance puts pressure on keeping a Microsoft environment.

The vendor lock-in situation with Microsoft is not necessarily a problem. The DTCA does not perceive a strong lock-in and sees options for future negotiation. They could just decide not to have a contract at the moment with Microsoft. Moreover, the situation

does not fall into the category of 'early adopter'. The DTCA is definitely not an early adopter. The DTCA is not working with the latest version of Microsoft and they do not need to. Besides, it requires a lot of time for the DTCA to transfer to the next version, so they postpone the transfer as long as possible. This results in the DTCA not being completely locked-in by Microsoft.

However, the DTCA still does not really have the possibility to switch, since their employees still want Microsoft. Microsoft remains to be a powerful company in the world. When Microsoft starts exerting their powerful position and increasing prices it can be problem. Besides, such a large powerful company can have high impacts on the world if something goes wrong.

In the future Microsoft is going to work with subscription in office 365. Subscription implies that companies will be paying for a license to use a certain product for a limited period of time. At the moment Microsoft offers licenses for an unlimited period of time. In the future situation the current strategy of only having a contract for a few years and then being able to continue to use Microsoft desktop office and not having to contract Microsoft for several years will not work anymore. This will give the DTCA less options with Microsoft. They will have to pay a subscription fee in order to make use of the Microsoft desktop and they may have to surrender to the prices stated by Microsoft.

## 5.5 Overview

This overview summarizes in which vendor lock-in categories the discussed vendor lock-in situations at the DTCA fit.

	SAP	Oracle	Genesys	Microsoft
Monopoly		✓	✓	
Intellectual Property Rights (IPR)		✓		
Technology dependence		✓	✓	
Early adopter			✓	
Switching costs	✓	✓	✓	
Network				✓
Incompatibility	✓	✓		✓
Personal lock-in		✓		✓

## 6. RECOMMENDATION VENDOR LOCK-IN SITUATIONS AT THE DTCA

In this section a recommendation for the analysed vendor lock-in situations at the DTCA will be proposed based on the corrective approaches discussed in section 4.

### 6.1 SAP

In the situation of the DTCA with SAP, the categories classified for the vendor lock-in are the switching costs and the incompatibility of the product. Besides, the vendor lock-in is strengthened by the education and habituation of thousands of employees with the SAP product. The organisation of the DTCA is intertwined with the product of SAP which makes the DTCA highly dependent on SAP. The DTCA could gradually try to

disconnect their organisation from the product of SAP by applying open standards stepwise in the environment around the SAP product. For instance, they can start by applying open standards in the financial department and then in the following years start the application of open standards in other departments step by step. The application of open standards makes the environment at the DTCA compatible and less dependent on the SAP product and therefore diminishing the vendor lock-in. By conducting this application of open standards gradually, the costs and impact of the switch are distributed over multiple years.

### 6.2 Oracle

Several categories for the vendor lock-in situation of the DTCA with Oracle are identified: monopoly, IPR, technology dependence, switching costs, incompatibility and personal lock-in. Any kind of changes in the tax collection environment, especially failure in change, are highly visible from political view. This means that any changes to the product or vendor relationship are more difficult.

Different approaches for the situation can be considered. The DTCA can establish a strategic partnership with Oracle to manage the monopolistic power of Oracle. The DTCA already applies a method of 'strategic supplier management' to manage their relationship with Oracle. However, the conducted analysis in this paper of the situation still implies an unfavourable vendor lock-in situation due to the monopolistic power of Oracle. The DTCA could try to enhance the partnership with Oracle more by for example involving Oracle in the DTCA process contributing to an improvement of their products. In this way the DTCA can leverage more from the current situation.

The DTCA can negotiate with Oracle about IPR assignment which would diminish the vendor lock-in and make it possible to switch to other suppliers. Nevertheless, it is questionable if Oracle would consider giving their IPR away since it is their major source of power and earnings.

The application of open standards in the environment of the DTCA around the product of Oracle is an approach which solves the issues of technology dependence, switching costs, incompatibility and personal lock-in and therefore removes the vendor lock-in. The DTCA can gradually apply open standards in their environment around the product of Oracle, so they become less dependent on Oracle and in the end obtain the possibility to switch. This can also put pressure on Oracle.

### 6.3 Genesys

The vendor lock-in situation of the DTCA with Genesys is desirable. In order to deal with the monopolistic power of Genesys, the DTCA has already applied the approach of 'procurement consortium' by working together with other consumers of Genesys. The DTCA could establish a strategic partnership with Genesys. The DTCA can cooperate with Genesys by involving Genesys in their business process to enhance the call centre platform.

The switching costs in the vendor lock-in situation are high but are not to be considered, since the DTCA does not want to switch.

The DTCA is an early adopter of the call centre platform and technologically dependent on Genesys. The DTCA conducts market analyses annually which demonstrate that Genesys is still leading on the market. Therefore, being an early adopter and technologically dependent is not a problem in this situation. As long as Genesys remains the best on the market, the DTCA can continue the situation.

This situation illustrates an example which could be used for other purchasing situations in public procurement.

## 6.4 Microsoft

The DTCA is in a vendor lock-in situation with Microsoft because of network, incompatibility and personal lock-in reasons. However, it is questionable whether the DTCA really wants to switch to another supplier in this situation. All the employees of the DTCA are experienced and used to work with the Microsoft desktop products. The Microsoft products work properly at the DTCA. The DTCA strengthened the dependency by building locally developed applications on the Microsoft desktop, but these applications do work well. If the DTCA would like to switch, it would take a lot of time and effort. The employees of the DTCA want the Microsoft products, so when the DTCA switches, they need to convince their employees of the new product. All the employees would need to be retrained to gain the experience with the new product.

The DTCA could try to disconnect their organisation from the Microsoft desktop by applying open standards on the Microsoft product and dismantling the locally developed applications. Again the DTCA should first consider whether they would like to change the current situation.

## 7. RESPONSE OF THE DTCA ON RECOMMENDATION

The recommendations and analyses of the vendor lock-in situations at the DTCA provided in this paper are discussed with the DTCA. The responses given by the DTCA are presented in this section.

### 7.1 SAP

The DTCA goes along with the analyses and recommendation given in this paper about the situation with SAP. The challenge is that changing this situation is not up to the purchasing department only. It is a complicated environment where continuity, changes in processes and a new way of working for a lot of people will imply slow change and possibly personal resistance. Especially administrative people who have been working in this environment for the last 20 years will feel the impact of a change.

They agree open standards may lead to less vendor lock-in. Nevertheless, as the financial decisions are made by the business, and functionally the environment is working fine, the purchasing department is not expecting the application of open standards soon.

### 7.2 Oracle

The DTCA agrees that they should talk with Oracle on a strategic level such as in a strategic partnership. However, they emphasize that in a strategic partnership it is important that both partners can influence each other. The DTCA should not have the illusion that they can exert influence on Oracle. They wonder if you can even speak about a strategic partnership with a global company like Oracle. Oracle has opposite interests of the DTCA. The DTCA is positioned in the public sector, is serving for society and has to comply with regulations, while Oracle has commercial interests derived from the American revenue model focusing on profit for shareholders. Therefore, the DTCA should look for another way of governing Oracle and try to find their own realization of a partnership with Oracle.

The DTCA understands the recommendation of IPR assignment for the IPR problem in the vendor lock-in situation with Oracle and agrees it would solve problems. However, negotiating with Oracle about IPR is extremely difficult. Oracle wants the vendor lock-in situation to continue, because it yields high profits for them. Furthermore, the DTCA would have to pay an enormous amount of money for the IPR assignment which is disproportional.

Open standards are regarded by the DTCA to be a proper recommendation for Oracle. Nevertheless, the DTCA should initially carefully consider all the legal details and complications of the application of open standards.

### 7.3 Genesys

The DTCA agrees with the recommendation for the establishment of a strategic partnership. They already apply the approach of strategic partnership to manage the vendor lock-in situation with Genesys. The DTCA is already working closely together with Genesys and they involve Genesys in their processes of the call centre platform so that Genesys can improve the platform and both parties benefit.

The DTCA indicates that indeed they do not want to switch at the moment because the platform of Genesys is seen by them as the best solution. However, the DTCA is currently investigating the possibility of other solutions. They are conducting research about the application of cloud solutions instead of the on premise solutions of Genesys at the moment. Genesys does not offer cloud solutions, so if the DTCA decides to switch to cloud solutions they would switch to another supplier. The DTCA has notified Genesys that they are considering and evaluating cloud solutions in order to keep Genesys alert.

Furthermore, the DTCA emphasizes that in order to be able to unite together with other customers of Genesys, it is especially important to visit all the conferences organised by Genesys. During these conferences the DTCA can maintain and expand their network with other customers of Genesys which enables the application of the approach 'procurement consortium'.

### 7.4 Microsoft

The DTCA goes along with the analyses and recommendation given in this paper about the situation with Microsoft. They agree that they do not see the necessity to switch to another product because the employees want the Microsoft desktop and nothing else and it is working. They expect that the switch to another product would lead to a lot of disturbance among the work force of the organisation.

However, the DTCA does not regard open standards as an approach for the situation with Microsoft. According to the DTCA, the compatibility problems are caused by different versions. Open standards will not solve the compatibility problems between different versions.

Since the DTCA is not going to switch and will be dealing with subscriptions in office 365 in the future, they are currently bundling government wide to develop a collective strategy for Microsoft. They are developing a collective contract format in which for example price agreements with Microsoft are fixed. At this moment government wide they are still only a small customer for Microsoft, so they worry about how much power they can exert against Microsoft if Microsoft will start abusing their power in the future.

## 8. DISCUSSION & CONCLUSION

There can be disadvantages of vendor lock-in like paying high costs and inefficiency. However, not in all vendor lock-in situations the potential disadvantages are present. Therefore, vendor lock-in does not always have to be an undesirable situation. The organisation can make the decision to just leave the situation as it is.

In order to differentiate the underlying reasons for vendor lock-in situations a categorisation is developed in this paper and a corresponding corrective approach is proposed. A purchaser can use this categorisation and the corrective approaches to analyse a vendor lock-in situation with a supplier and consider the proposed approaches, as presented by the vendor lock-in situation at the DTCA.

One vendor lock-in situation can fit into several categories. These categories may have contradictory suggested approaches. For example, for the category of monopoly a strategic partnership with the supplier is recommended which leverages the dependency, while for the category of incompatibility the application of open standards is proposed which diminishes the dependency on the supplier. There is no integral approach of several categories suggested in this paper, but only a specific approach per category. Future research could develop more specific vendor lock-in categories which can be combinations of the categories developed in this paper. By combining categories an integrated approach for a situation fitting into several categories could be developed.

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## 10. APPENDIX

### 10.1 Appendix A

These are the keywords that are used for the literature review about vendor lock-in in general: vendor lock-in, supplier lock-in, IT lock-in, technological lock-in, public procurement lock-in, IT public procurement lock-in, supplier dependency, leveranciersafhankelijkheid, leveranciersafhankelijkheid ict, overheid leveranciersafhankelijkheid, overheid ict vendor lock-in

### 10.2 Appendix B

These are the keywords used for the analyses about the vendor lock-in categories:

- Monopoly: monopoly, monopoly vendor lock-in, monopoly supplier dependency, monopoly public procurement, monopolie ict overheid

- Intellectual Property Right: intellectual property right, intellectual property right vendor lock-in, intellectual property right supplier dependency, IPR vendor lock-in, IPR supplier dependency, IPR patenting, IPR licenses, IPR IT, IPR public procurement, intellectueel eigendom ict, intellectueel eigendom ict overheid

- Technology dependence: technology dependence vendor lock-in, technology dependence supplier dependency, technology dependence path dependence, path dependence lock-in

- Early adopter: early adopter technology, early adopter vendor lock-in, early adopter supplier dependency

- Switching costs: switching costs, switching costs vendor lock-in, switching costs supplier dependency, switching costs buyer, switching costs IT, switching costs public procurement, hidden IT costs

- Network: network effect, network externalities, network vendor lock-in, network supplier dependency, network public procurement

- Incompatibility: incompatibility, incompatibility vendor lock-in, incompatibility supplier dependency, incompatibility technology, incompatibility IT, incompatibility public procurement, incompatibility standard

### 10.3 Appendix C

These keywords are used for the literature review for recommendations for vendor lock-in: dealing with vendor lock-in, vendor lock-in approach, dealing with supplier dependency, approach vendor lock-in public procurement, vendor lock-in open standards