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# From standardisation, through integration and automation, into machine-to-machine communication

## A field problem solving project at Philips Lighting B.V.


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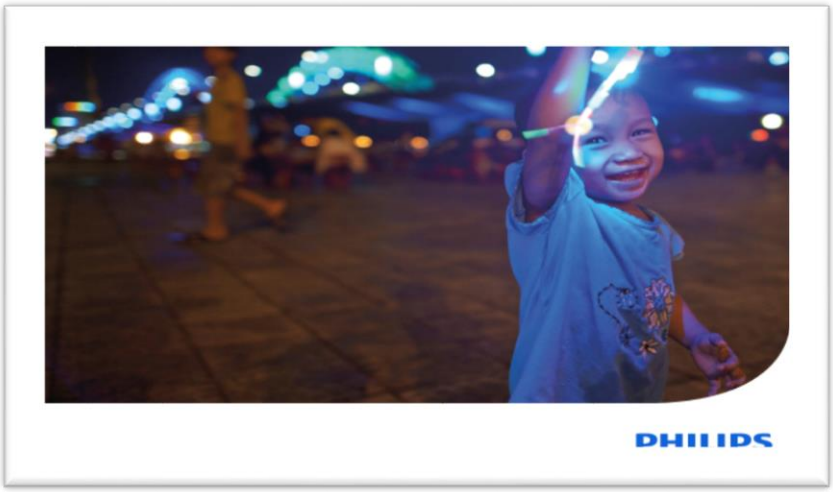


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# Management summary: the proposal of a detailed solution to increase the performance of the Purchase-to-Pay process

This research is conducted at Philips Lighting B.V., the largest lighting company in the world. Philips Lighting BV focuses on both conventional lighting and LED technology. Scope of this research is the Indirect Materials & Governance procurement department. As the company is only a stand-alone firm since February 2016, some systems they use are still shared or 'rented' from the company they used to be part of, Royal Philips. To become a fully stand-alone company Philips Lighting B.V. initiated a project to replace their shared procurement tool "Supplier Relationship Management" or SRM. After benchmarking the company chooses to implement the SAP Ariba cloud based procurement solution. Ariba already provides Philips Lighting with their contracting tool and therefore the choice for Ariba as the operational procurement solution might increase the likeability of end-to-end integration in the near future. Reasons for the implementation of a solid e-procurement system are furthermore a current low compliancy scores, a high level of user issues and a Total Service Level Agreement with Royal Philips, which means the company is not allowed to use the current SRM tool for a period of one year after the split.

The abovementioned issues with the current procurement tool serve as the basis for the research question of this research. This thesis focuses on the added value of the Purchase-to-Pay process in achieving desired and compliant usage of buying channels and preferred suppliers for the complete set of clusters within Indirect Materials & Governance procurement. The research question of this research is: *To what extent does a new e-procurement solution ensure that the preferred buying channels are followed and the preferred suppliers are being used by internal stakeholders?*

A literature review analysed the possible reasons that lie beneath performance issues of the Purchase-to-Pay process. Furthermore, literature on e-procurement and electronic markets, the Industry 4.0 paradigm and the state of the art of current available software was analysed to investigate possible opportunities and future possibilities to create a desired end state of the Purchase-to-Pay process of Philips Lighting B.V.

The analysis of the current performance of the Purchase-to-Pay process of Philips Lighting B.V. showed a Purchase Order compliancy of less than 90%, which is below the desired target. A scattered supply base makes it difficult to focus on mature supplier management within the Indirect Materials & Governance procurement department. Overall, the current state of the performance of the Indirect Materials & Governance procurement department is on average below the 2016 targets and therefore at a lower level as the company in general and the management team in specific is aiming for.

To bridge the gap between the current state and desired state a multiple-year roadmap is developed and proposed to provide the company with a few handles in there transformation journey of the Indirect Materials & Governance procurement department. Figure 1 shows the detailed roadmap from 2017 to 2021 onwards including eight layers focused on the processes, the physical aspect of procurement, sourcing, item taxonomy and reporting, accounts payable, supplier management, procurement strategy, and buying channels.

A key success factor for bridging the gap is the support and buy-in of senior management. For a project that changes the way-of-work for many people inside the organization there should be a delicate balance between steps moving forward, change management, and the way(s) of informing stakeholders.

Although many initiatives focused on an efficiency and effectiveness increase were conducted over the course of 2016, the current state shows that Philips Lighting Indirect Materials & Governance procurement is not yet fully ready to join the fourth industrial revolution. This internet revolution in manufacturing, often called 'Industry 4.0 paradigm'[1], is seen as the next chapter for many companies. The Indirect Materials & Governance procurement department did not went through the necessary evolution and maturity stages needed to be at the doorstep of the Industry 4.0 at the start of 2017. However, a solid end-to-end framework and project roadmap can serve as guidance to take the necessary steps forward.

Once the doorstep of the Industry 4.0 paradigm is reached, a commodity that might be interesting to run a pilot with in terms of cyber-physical systems is road distribution. Road distribution can potentially be ordered and steered automatically based on data analysis of e.g.

[1] See Agarwal & Brem (2015), p. 197.

the sales orders, the sales trend, the stock levels of factories and stores, and many more parameters.

As the author, I believe that the proposed roadmap can support Philips Lighting B.V. in their journey from standardization, through integration and automation, into machine-to-machine communication and, eventually stepping into the fourth industrial revolution.

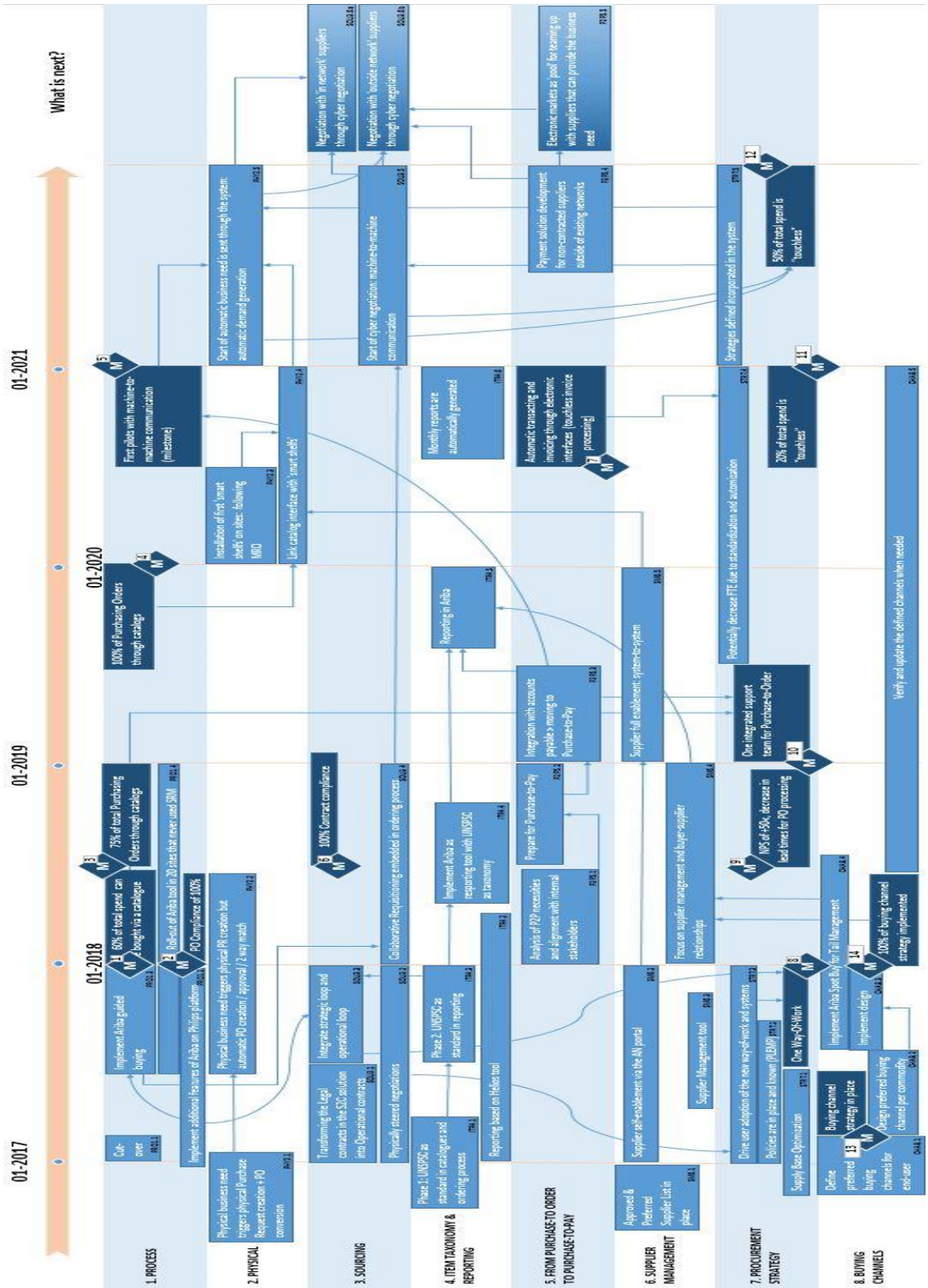


**FIGURE 1 - DETAILED ROADMAP FROM 2017 TILL 2021 ONWARDS**

# Preface

This thesis is the result of a journey of seven months. It is the final chapter of the Master Business Administration with a specialization in Purchasing & Supply Management. Next to that it is the final chapter of a bit more than five amazing years at the University of Twente. It all started with the Bachelor International Business Administration, followed by a semester abroad at the Tallinn University of Technology, through the Master courses and ended in Eindhoven with an internship at Philips Lighting.

The journey that I went through, and I am still going through, was not possible without the support of my family, friends, professors, colleagues and many others. I am grateful that I got many opportunities along the way and I feel proud that I took them.

I would like to take this moment to express my gratitude to the ones who helped me achieve this final stage of my student life.

First of all, I would like to thank my supervisor at the University of Twente. The start of my internship was hard with little guidance and no clear project defined by the company, but you stood by me and supported me. Professor Schiele, the discussions and brainstorm sessions we had impacted this thesis in a positive way and made me think outside-the-box.

Next I would like to thank my colleagues at Philips Lighting. George, for your support and guidance, especially in the first few months of my internship. Paul, for the opportunity you gave me in the P2O project. Louk, for our discussions and brainstorm sessions. And Iris, for your clear feedback and time, even though you were busy with your own new adventure.

Last but definitely not least I would like to thank my family and friends. Especially my parents and Mark. You had the patience to listen to my yammering, thank you for bearing with me!

I am very happy that I was given the opportunity to implement this thesis even further within the company and that I will join Philips Lighting from January 2017 as an employee.

Only thing rest to say for now: I hope that you will enjoy reading this Master Thesis.

Yours sincerely,

Robin Hazelaar

Eindhoven, November 27, 2016

# List of abbreviations

| | |
|---|---|
| BSS | Business Strategy and Services |
| CIF | Catalogue Interchange Format |
| CLOGS | Classification of Goods and Services |
| F&D | Freight & Distribution |
| HR&M | Human Resources & Mobility |
| IaaS | Infrastructure as a Service |
| IBS | IT & Business Strategy & Services |
| IRE | Industrial & Real Estate |
| IND | Industrial |
| IT | Information Technology |
| MME | Media, Marketing & Events |
| PaaS | Platform as a Service |
| P2P | Purchase-to-Pay |
| P2O | Purchase-to-Order |
| PO | Purchase Order |
| SaaS | Software as a Service |
| S2C | Source-to-Contract |
| RE | Real Estate |
| UNSPSC | United Nations Standard Products and Services Code |
| VGU | Vendor Global Ultimate |
| XML | extensible Mark-up Language |

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# Contents

# 1 Indirect Materials & Governance procurement at the largest conventional lighting and LED firm in the world

## 1.1 Introducing a renewed stand-alone company in its midst of taking ownership and defining a clear purpose

Royal Philips N.V. is, officially until the beginning of 2016, known as a leading global technological firm in the areas of healthcare, consumer lifestyle and lighting. The company was founded over a century ago, in 1891, by Frederik Philips. They started out small with a modest factory in Eindhoven, the Netherlands. Since then the company grow a lot, mainly because of their innovative and entrepreneurial focus. A research laboratory was started in 1914 to stimulate product innovation and in the years after diversification of its product range began.[2]In 2015 the company generated €24.244 million in sales.

As mentioned before, Royal Philips divided its business originally in three divisions: healthcare, consumer lifestyle and lighting. Healthcare and consumer lifestyle together showed a sales figure of €16.259 billion in 2015. The lighting division showed €7.411 billion of sales. The company employs 112,959 employees working in these divisions worldwide, as on the 31st of December, 2014.[3]

In 2016, many years after the start of the company, another historical event took place. The Chief Executive Officer of the company announced in 2014 that Philips was going to split its business in two stand-alone companies. On the 7th of May, 2015, this separation was approved at the Annual General Meeting. Following this approval Royal Philips went through an organizational change over the course of a few months with, as a final step, the split between the lighting division and healthcare and consumer lifestyle.

What used to be one company is now continuing as Royal Philips BV and Philips Lighting Holding BV (hereinafter referred to as Philips Lighting). On Friday the 27th of May, 2016, Philips Lighting listed their Initial Public Offering at the Amsterdam Stock Exchange. Initially

[2] See Philips (y.u.). p, n/a.
[3] See Philips (2015), p. 4.

25% of the total shares were listed.[4] Important to note is that this research was conducted within Philips Lighting. Philips Lighting has approximately 36.000 employees in more than 70 countries worldwide. In the first half year results of 2016 it was shown that the adjusted EBITDA[5] increased from €249 million in the first half year of 2015 to €282 million in the first half year of 2016.[6] Philips Lighting has given its renewed company a clear purpose; "to unlock the extraordinary potential of light for brighter lives and a better world."[7] Values that support this purpose are customer first, greater together, game changer and passion for results. These values show that Philips Lighting wants to beat expectations, value diversity, dare to do, take charge and achieve excellence. This all is supported by acts of integrity.[8]

Since the split the focus is on creating a stable company which operates independently of Royal Philips. In order for that to happen, a split on paper, a physical move and a clear purpose is not enough. The processes, systems, employees and complete infrastructure need to be rebuild to fit the Philips Lighting business model. This need was the initial trigger for a lot of projects focused on splitting the core processes and systems. Following this need for independence the procurement department of Philips Lighting has taken steps to implement a new cloud-based e-procurement solution to increase the performance of the Purchase-to-Pay process and to increase the independency of the company.

[4] See Ritzen (2016), p. n/a.
[5] Earnings Before Income, Tax, Depreciation and Amortization.
[6] See Philips (2016a), p. n/a.
[7] Philips (2016b), internal presentation.
[8] See Philips (2016b), internal presentation.

## 1.2 The Philips Lighting procurement organisational structure exists of a Bill of Materials and Indirect Materials and Services division

### 1.2.1 The scope of this research is the Indirect Materials & Governance procurement, existing of several commodity clusters, global procurement domains, and domain experts and support

The procurement department of Philips Lighting consists of two divisions, namely Bill of Materials and Indirect Materials & Governance. This research is conducted within the Indirect Materials & Governance division.

The Indirect Materials & Governance procurement department exists of five Indirect Material Commodity Clusters, five Global Procurement Domains and three supportive areas. Figure 2 shows all teams working in the Indirect Materials & Governance procurement department at Philips Lighting. The commodity clusters are Information Technology (IT) & Business Strategic Services (BSS) which together form Information & Business Services (IBS), Human Resources (HR) & Mobility which together form HRM, Industrial (IND) & Real Estate (RE) which together form IRE, Freight & Distribution (F&D) and Marketing, Media & Events (MME). Although there are five clusters defined in the organisational chart, internal reporting and communication is based on seven clusters. The clusters ISS, which combines IT and BBS and IRE, which combines IND and RE, are approached as four instead of two clusters, although driven by two cluster leads. This is an important decision as this thesis will continue with a focus on seven cluster groups.

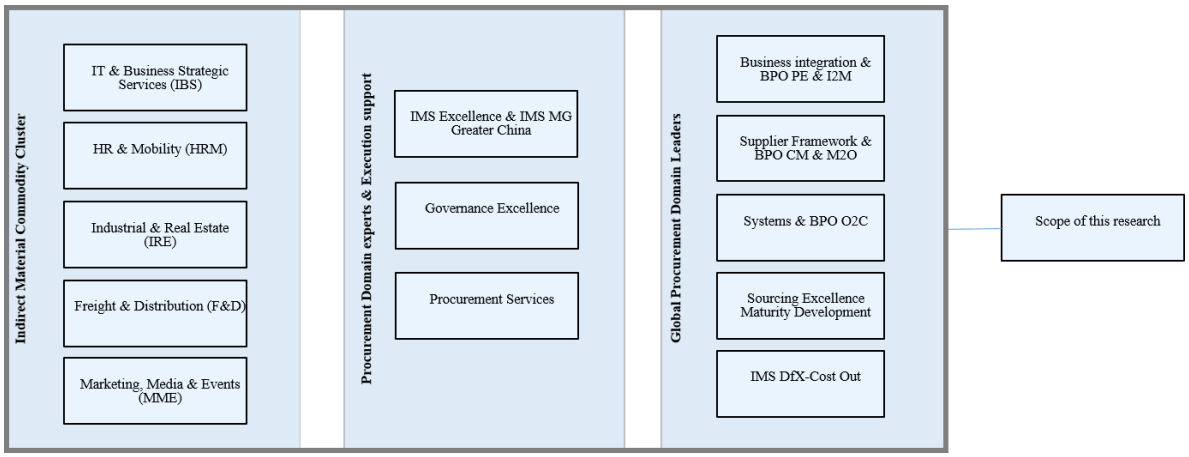


**FIGURE 2 – ORGANISATIONAL CHART INDIRECT MATERIALS & GOVERNANCE PROCUREMENT**[9]

Each cluster consists of a group of commodities and has its own way(s) of working. In addition to the department wide tools and systems used, each cluster has its own systems.

This thesis focuses on the added value of the Purchase-to-Pay process in achieving the desired usage of buying channels and preferred suppliers for the complete set of clusters in Indirect Materials & Governance procurement.

### 1.2.2 A commodity can be broken down into several Classification of Goods and Services codes (CLOGS)

As mentioned before, each cluster consists of a group of commodities that are steered by a commodity lead. In total Indirect Materials & Governance procurement included 62 commodities in 2016. All commodities can be separated into several Classification of Goods and Services codes (hereinafter referred to as CLOGS). In July 2015, there were 137 unique CLOGS. Table 1 shows an example of hardware and the related CLOGS to this commodity.

[9] Source: based on internal Philips Lighting BV documentation.

| Commodity Cluster Name | Commodity Name | CLOGS Name |
|---|---|---|
| IT | HARDWARE | DESKTOPS & LAPTOPS |
| IT | HARDWARE | MOBILE DEVICES |
| IT | HARDWARE | SERVERS & STORAGE (INCL. MAINTENANCE AND SUPPORT) |
| IT | HARDWARE | PERIPHERIALS |
| IT | HARDWARE | PRINTING & COPYING DEVICES |

**TABLE 1 - COMMODITY HARDWARE AND RELATED CLOGS**

In October 2016 the decision for a new taxonomy was made. A mapping table of the internally used CLOGS to the United Nations Standard Products and Services Code (or UNSPSC)[10] was created. This decision was made to prepare the processes and systems for a leap forward in terms of efficiency, standardization and control. This choice is outlined in the problem statement of this research, which can be found in Chapter 1.3. For the time being, CLOGS will still be used internally. As a second phase the internal processes, systems and reporting tools will also move to UNSPSC to create alignment. When the roll-out of this second phase exactly will be, was during the process of writing this thesis (till December 2016) not yet known.

## 1.3 The current Purchase-to-Pay process is not performing as desired, and the implementation of a new e-procurement solution acts as the first step towards performance improvement

The split between Royal Philips BV and Philips Lighting BV started with establishing a stand-alone structure for Philips Lighting within the Philips Group effective as of the 1st of February, 2016, after many months of preparations. The completion of the separation is a time consuming

[10] See UNSPSC (2014), p. n/a.

process and initially it was stated to be announced in the first half of 2016. This official statement of the separation was the biggest trigger for many projects on splitting the core processes and systems to start.

One of these impactful projects is the "Supplier Relationship Management (hereinafter referred to as SRM) tool replacement" project. This project is facilitated by the Systems Global Procurement domain and spans the whole Indirect Materials & Governance procurement within Philips Lighting. The project is focused on the replacement of the current e-procurement system, SRM. After a few months of information gathering, benchmarking and negotiations it was decided that Ariba will become the provider of the new e-procurement ordering system for Indirect Materials & Governance procurement. The choice for Ariba was partly made because Ariba is already providing Philips Lighting with their contracting tool. Other important reasons for partnering up with Ariba are the additional features, and opportunities, that their software and global network can bring to the company.

Reasons for the implementation of a solid e-procurement system are user issues such as low compliancy, low efficiency and lack of easy way-of-work, and the need for independence from Royal Philips. These reasons will be explained in more detail in the fourth chapter of this thesis. Furthermore, the new solution should increase the performance of the Purchase-to-Pay process within Philips Lighting. The Purchase-to-Pay process within Indirect Materials & Governance procurement spans the whole buying process from selection to invoice. This process is explained further in detail in Chapter 2.1.

One of the issues within the current Purchase-to-Pay process is a need for buying channel strategy. The definition of a buying channel, as used in this thesis, is the process in place for the creation of a purchase order. Examples of buying channels are; creation a purchase order by means of a catalogue search, by means of a broker or third party, or by means of a limit order.[11] With buying channel strategy, the strategy behind the choice for a certain buying channel for a certain category of goods and/or services is meant. A strategy is a high level plan that works as the integrator to create a cohesive whole out of an organization's major goals and actions set.[12]

[11] A limit order is a purchase order that is opened for a period of one year. During that year purchases and invoices can be booked against that limit order, but limited by an upfront set budget.
[12] See Quinn (1980), p. 14.

The preferred buying channel, so the preferred way to order goods and/or services, is in most cases known by the commodity manager of a certain product or services category. For example, the commodity manager for travel expenses informs the internal user community that travel expenses should be booked by making use of a third party ordering tool, named Concur. The preferred buying channel for the category travel expenses is therefore a third party tool. At the moment, the user community is often informed by the community managers separately. There is no clear documentation that shows the preferred buying channels for the Indirect Materials & Governance department as a whole. There are plans to have the preferred channels outlined in the PLEMP (the Philips Lighting Expense Management Policy). However, during the writing of this thesis, the implementation of buying channel strategy within the PLEMP was not yet realized. A clear overview of preferred buying channels and preferred suppliers might potentially increase compliance and efficiency in way-of-work because it supports the user community in following the desired channels and using the preferred suppliers. Usage of preferred buying channels and preferred suppliers might result in the achievement of savings through framework agreements or other benefits. These potential benefits will be discussed in the next sections of this paper. As long as the user community, which is located across the world in local offices and sites, is not fully aware of the strategy and policies they are not enabled to comply. The current buying channels identified are based on a deep dive with three consultancy firms and five multinational company benchmarks in 2013[13]. Now, three years later, the need for a solid buying channel strategy is still there.

Therefore, this research aims to deliver a roadmap for the next five years with clear guidance and action steps. Reason for this roadmap is to give the Indirect Materials & Governance procurement department a clear structure and plan moving forward. Starting point of this roadmap is the current situation of the company. The desired end state of the roadmap is designed based on the state of the art available in academic literature. The possible steps and decisions between the current state and the desired state are extensive. A roadmap can help to break-down the overall goal and create clear short-term projects and goals that fit the journey towards the desired end state. This deliverable is not created overnight. Consequently, a structured approach is necessary.

[13] See Capgemini Consulting (2013), p. n/a.

In the next section the research question and complementary sub-questions are introduced. After that current literature on buying channels and channel strategy is reviewed by means of a literature review. The section following this outlines the methods used in this research and the complementary research process. Chapter four shows the starting point of the roadmap; the current situation within the Indirect Materials & Governance procurement department. Next the roadmap is presented by means of a desired state of way-of-work, buying channels and supplier usage. This will be followed by a conclusion to answer the research question. This research will end with managerial considerations following the conclusion and suggestions for further research.

## 1.4 Several stakeholders are involved in this research and clear communication between them is key for success

For a clear understanding of the scope of this project it is important to understand which stakeholders are involved. All stakeholders involved with this research are outlined in Table 2. The internal user community of over 4.000 people are the ones that have a need for a certain product and/or service. These people are the business and the internal customers of the Indirect Materials & Governance procurement depart, another important stakeholder.

At several locations in the world a procurement service centre is situated. This centre serves as a back-office and supports the internal user community if issues arise. Furthermore they act as back-office for the Indirect Materials & Governance procurement cluster teams, and the team conducts analysis and provides reporting. The transaction service centre is an outsourced third party that supports the company in checking the purchasing requests and completing missing information if needed. The finance department is an important stakeholder looking into the future. Integration across the chain, from negotiation till payment, is an important prerequisite for automated buying.

The Ariba back-office supports the project team if technical issues arise. The catalogue team is focusing on the content available in the new cloud-based e-procurement solution. The author is part of this team. Last but not least the supply base is a major stakeholder in this project. Without suppliers enabled on the Ariba Network, the project is hard to succeed.

| **Stakeholders** | **Responsibilities** |
|---|---|
| Internal user community of over 4.000 users worldwide | Create purchase orders in the e-procurement solution |
| Indirect Materials & Governance procurement department | Creating commodity strategy and the selection of preferred suppliers and preferred channels |
| Procurement Service Centre (PSC) | Support the internal user community + other tasks |
| Transaction Service Centre (TSC) – Outsourced to an external party | Completion of purchase requests of the internal user community based on instructions from procurement and reject or accept purchase requests + other tasks |
| Finance department | Joining the design phase of the e-procurement solution project to assure that alignment with financial standards and way-of-work is in place |
| Ariba back-office | Support the catalogue team and suppliers with technicalities and system related questions |
| Catalogue team | Delivering the new e-procurement solution to the internal stakeholders and enable suppliers and internal users to implement the usage of the new system in their daily way-of-work in a correct manner. Being available for business related questions to all stakeholders involved |
| Suppliers | Support Philips Lighting B.V. with the necessary information and technicalities to join them in their process and system change |

**TABLE 2 - STAKEHOLDERS INVOLVED IN THIS RESEARCH AND THEIR RESPONSIBILITIES**

## 1.5 The extent to which a new e-procurement solution ensures the usage of preferred buying channels, and preferred suppliers, by internal stakeholders is the foundation of designing a solution for the research problem

The research question of this research is: *To what extent does a new e-procurement solution ensure that the preferred buying channels are followed and the preferred suppliers are being used by internal stakeholders?*

This research question is created as it blends together two important topics currently discussed within the company. One of these topics is buying channels and the desired way to order products and services. The other topic reflected in this research question is the supply base of the company in general and the usage or choice for suppliers by internal stakeholders in particular. To answer this question in a structured way five sub-questions are formulated. Each of them is described and discussed below.

Sub question 1a: *What are the buying channels used within Indirect Materials & Governance procurement?*

This question is important to get an overview of the current state of Indirect Materials & Governance procurement concerning buying channels. Before focusing on the future possibilities and opportunities, an understanding of the current state is necessary.

Sub question 1b: *How can the preferred buying channels within Indirect Materials & Governance procurement be identified?*

Next the preferred buying channels should be identified. This is done based on a design phase of the possibilities that Ariba will bring. This will combine the needs of both the commodity managers, based on their commodity strategy, and the end-users, based on ease of use and expectations.

Sub question 2: *To what extent differs the preferred supplier base from the supply based used within Indirect Materials & Governance procurement?*

Sub question two focuses on the desired way of work in terms of supplier usage by internal stakeholders versus as is. If a gap exists, what should be done to close it and to make sure that the preferred suppliers are used by the internal user community.

Sub question 3a: *How to ensure that the preferred suppliers are used by the end-user?*

This sub question answers the steps to take in order to reach a desired end state. The steps to take together form a path that takes the company on a journey towards optimal performance in terms of supplier management and contract compliance.

Sub question 3b: *How to ensure that the preferred buying channels are used by the end-user?*

This sub question brings together the desired end state in terms of supplier choices and buying channel usage. The road towards full compliancy in buying channel choices will be sketched.

Next section of this paper will review academic literature on buying channels, reasons that lie beneath performance issues of the overall Purchase-to-Pay process, e-procurement in general, cloud computing in specific and the possible next step in ensuring desired way-of-work; the Industry 4.0 paradigm.

# 2 Literature review

## 2.1 Possible reasons that lie beneath performance issues of a Purchase-to-Pay process: Maverick buying, lack of pooling, lack of business process control and low efficiency

### 2.1.1 Purchase-to-Pay process; every step taken from the initial need for a product or service to the payment of the received invoice to the supplier

Purchase-to-Pay, procure-to-pay or just P2P, is the process covering all the necessary steps that are involved in Business to Business procurement: from a procurement need to receiving and paying the invoice to the supplier. Purchase-to-Pay is said to be one of six core businesses in Enterprise Resource planning, focused on "procurement of, and payment for, all materials required..."[14] Each step has an underlying process. How that process exactly looks like depends on the tools in place. A paper based process differs from a cloud solution based process. However, the high level process is the same. The process start with a need of the user, flows through the role of procurement as intermediary between the user community and the supplier community and, eventually the financial department is taking care of the financial approval process and payment to the supplier community. Figure 3 shows these main features of the Purchase-to-Pay process on a high level.

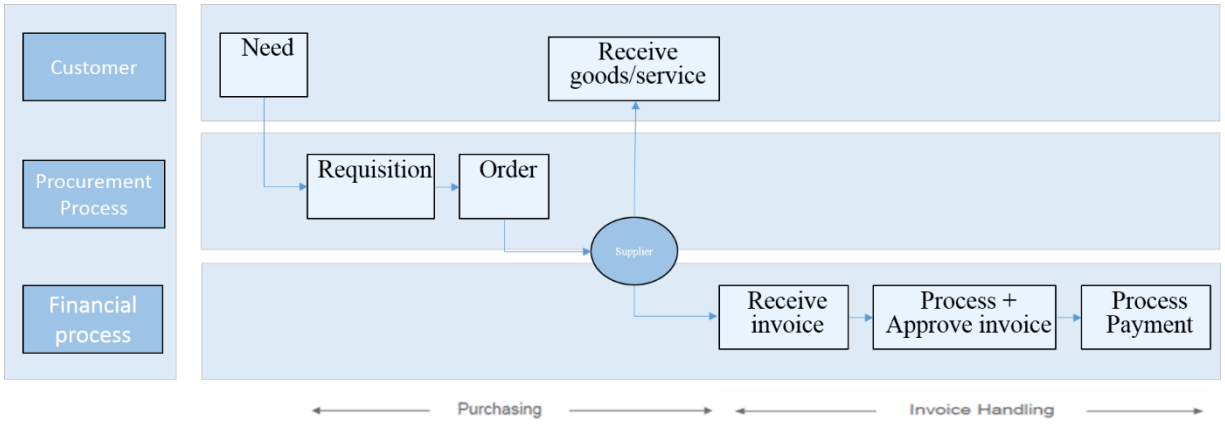


**FIGURE 3 – HIGH LEVEL PURCHASE-TO-PAY PROCESS OUTLINED**

[14] Okrent & Vokurka (2004), p. 639.

The Purchase-to-Pay process is only one of many processes within an organization. Other examples of processes are Application-to-Approval, Issue-to-Resolution and Order-to-Cash.[15] All these processes show a small part of the way the organizing is run in a detailed way. These business processes together are in most companies managed by a business process management (or BPM) team or department. BPM is "the art and science of overseeing how work is performed in an organization to ensure consistent outcomes and to take advantage of improvement opportunities". [16]

### 2.1.2 An in-depth literature analysis into the concepts of maverick buying, pooling of demand, business process control and efficiency

#### 2.1.2.1 Decreasing maverick buying; non-compliant purchasing behaviour, will increase compliancy rates and this achievement of business process control ensures that policies are followed

What is maverick buying and more important, why does it exist and what can be done to stop it? The first step in answering this question is to get a clear definition on the role of procurement within an organisation and whom it serves; in other words who are its customers. Purchasing "is used to be viewed as a clerical job of buying the materials requested by users".[17] In the 1970s this administrative role was still visible, with a focus on being "a service provider to other functions within the enterprise, with the primary task of buying the required goods and services…"[18] But the role of the procurement function has evolved over the past years and is well documented in academic literature as well. As said, traditionally, the procurement function is given a supportive, administrative and transactional role. Nowadays the procurement function is more and more perceived as a strategic part of the organisation. [19] This strategic role is aimed at helping the organization to achieve its mission.[20] The change from traditional to strategic did not take place overnight. Already in 1983 Kraljic identified four stages of purchasing

[15] See Dumas et al. (2013), p. 1-2.
[16] Dumas et al. (2013), p. 1.
[17] Monczka et al. (2010), p. 14.
[18] Cousins et al. (2008), p. 12.
[19] See Cousins et al. (2008), p. 11-14, Tassabehji & Moorhouse (2008), p. 55, and Quesada et al. (2010), p. 517.
[20] See Monczka et al. (2010), p. 25.

sophistication based on the level of importance of the purchasing function within the company and the complexity of the supply market.[21]

Literature provides several closely related definitions for maverick buying. These were combined into the following definition: "as the off-contract buying of goods and services for which an established procurement process is in place based on pre-negotiated contracts with selected suppliers."[22]

Direct customers of the procurement department are the colleagues within the organization that purchase goods and/or services on a daily (or weekly/monthly) basis. The procurement department serves these internal customers or user community with processes and tools to order. The internal user community does not need to spend time on sourcing, contract management, negotiations, maintenance, process management, etc. In this way the internal user community can focus solely on their core tasks and the purchase-to-order process is controlled and managed by the procurement department. But as the internal user community is in most companies the ones who actually create purchase requests it is important that this community understands the way-of-work of the processes, is compliant with the procurement rules and regulations and adheres to set procurement policies.

By means of a systematic literature review, interviews and a case study three forms of maverick buying are defined. First form is maverick buying to get better terms and conditions. In this case the internal customer might believe that buying from a non-preferred local supplier with a lower price is the best option to go with. Unfortunately, they do not take into account the impact of this on the total cost of organization due to the risk that framework contracts set with the preferred suppliers, like for example for framed volumes, will not be met. Second form is maverick buying due to unawareness of frame agreement existence. This one happens mostly in the area of indirect materials and services and is caused by a lack of communication of company policies and contract details. This lack of communication is not intentionally but with many buyers within the firm clear communication and sharing of the desired way of work is difficult. Third form is maverick buying to maintain an existing supplier relationship. This form is about human habits to prefer the status-quo and to remain the relationship, often a personal

[21] See Kraljic (1983), p. 111.
[22] Karjalainen et al. (2008), p. 248.

one, with the old non-preferred supplier which they are doing business with for years.[23] As a clear communication on policy sharing and the desired way-of-work is necessary to get the internal customers act in a compliant way priority should be given to get buy-in from internal customers. Non-compliance and resilience for adoption and use of the standardized e-ordering system is also influenced by the resistance of internal users for breaking up previous supplier relationships.[24]

Moving towards the impact of e-procurement solutions on maverick buying it is found that the use of electronic, web-based procurement systems brought efficiency, speed and ease of use for internal customers who, at their turn, acted in a compliant way. [25] Compliancy was in this case triggered by internal customer satisfaction. The latter is important as in essence "compliance is ensuring that business processes, operations and practice are in accordance with a prescribed and/or agreed set of norms."[26] Not only clear communication and information sharing is key, the e-procurement tool in place should also meet the expectations of the internal customer. The user's perception of the e-procurement provision is influenced by the level of professionalism of the support function, the quality of the training received to be able to work with the e-procurement solution, the level of usability of the system, the quality of the content on the system, the impact of the e-procurement system on performance and the functionalities of the system, e.g. the ability to integrate with finance.[27] Gender, age, experience and the voluntariness of use act as moderators in the relationship between performance expectancy of the system, the effort expectancy and social influence and the behavioural intention of the user which eventually reflects the user behaviour.[28]

[23] See Karjalainen & van Raaij (2011), p. 187 – 188.
[24] See Arbin (2008), p. 149.
[25] See Croom & Johnston (2003), p. 539.
[26] Sadiq et al. (2007), p. 149.
[27] See Brandon-Jones & Carey (2011), p. 277-279.
[28] See Venkatesh et al. (2003), p. 447.

#### 2.1.2.2 Pooling of demand decreases the number of purchasing orders and ensures a stronger bargaining position facing suppliers

As discussed before, the strategic value of purchasing is acknowledged in literature, but the contribution of the purchasing function to the overall business performance is not yet extensively analysed.[29] To create guidance for such analysis a model was defined that helps understand the impact of the purchasing function on the overall business performance. In this model the purchasing strategic objectives and competitive priorities needs to be strategically aligned with the business strategy moving forward. Once strategic alignment is in place choices and decisions can be made within the purchasing function. A strong implementation strategy will drive purchasing performance and capabilities which in its turn will drive business performance. [30] On this strategic role of the purchasing function a five level strategy development model in purchasing was build.[31] The highest level, level I, is the firm strategy. Below that functional strategies, of which purchasing is one of them, are defined as level II. Level III is category strategy. Level IV is the strategy per tactical sourcing 'levers' and level V is the supplier strategy.[32]

Pooling of demand is one of several tactical sourcing 'levers' defined in literature, located at Level IV in the before-mentioned strategic structure. Different models to discuss these 'levers' are defined. In light of this research we discuss the sourcing lever model as proposed by Schiele et al. (2011). In total seven 'levers' are defined. These are volume bundling (or pooling of demand), price evaluation through enhanced negotiation concepts, extension of the supply base (or supplier integration strategies), product optimization, process optimization, international sourcing and category-spanned lever.[33] Pooling of demand is the exercise in which a company bundles its own demand internally. Pooling of demand in a broader sense can be bundling of volumes by a couple of companies to establish a stronger buying power with its suppliers.

In the Purchase-to-Pay process the result of pooling of demand might be the decrease of purchasing orders. As example: an internal customer that is responsible for the stock level of

[29] See González-Benito (2007), p. 901.
[30] See González-Benito (2007), p. 904.
[31] See Hesping & Schiele (2015), p. 139.
[32] See Hesping & Schiele (2015), p. 139.
[33] See Schiele et al. (2011), p. 322-323.

first aid kits within three or four factory sites might be ordering a replenishment every time an item from the kit is used. If the internal customer approaches the replenishment ordering with a pooling of demand strategy, he or she might decide to order new complete first aid kits for all factory sites every two months. In this way the ordering amount per order is higher, and the sequence of ordering is lower. The impact of the volume bundling lever depends on the type of items that are bought. Kraljic (1983) defined four quadrants as a framework for developing supply strategies: leverage, strategic, non-critical and bottleneck. [34] Products or services in each of these quadrants differ from each other in terms of the purchasing strategy that lies underneath. Products or services in the leverage quadrant thrive best with the development of strategic partnerships and exploitation of buying power. Products or services in the strategic quadrant thrive best with the maintenance of strategic partnerships, terminations of partnership and the search for new suppliers or the acceptance of a locked-in situation with suppliers.[35] A combined view of the Kraljic matrix and the strategic sourcing 'levers' shows that pooling of demand is more frequently applied in the strategic approach for leverage and strategic products or services then for non-critical or bottleneck products or services.[36] This result fits with the general strategy for the leverage quadrant; the exploitation of buying power.

To conclude; for the pooling of demand 'lever' to add value to the Purchase-to-Pay process and increase performance an analysis on category level should be made before the implementation of the strategy.

#### 2.1.2.3 An increase of procurement efficiency is only possible when a clear performance measurement system is in place and works accordingly

Implementing e-souring tools in the hope that efficiency will increase is not enough to make that desire of efficient way-of-work a company standard. As discussed in the Chapters 2.1.2.1 and 2.1.2.2, implementing e-sourcing tools will not realize predicted savings if there are no clear control mechanisms in place to reduce maverick buying, and to clearly structure procurement policy implementation and roll-out. A case study conducted at an international pharmaceutical

[34] See Kraljic (1983), p. 112.
[35] See Caniëls & Gelderman (2005), p. 143.
[36] See Hesping & Schiele (2016), p. 110.

company shows a 3-phase approach to improve purchasing efficiency. Phase 1: gather data to identify key areas of noncompliance. Phase 2: identify the causes of noncompliance. Phase 3: design mechanisms, systems and incentives to ensure compliance. [37] Especially this last phase, design mechanisms, systems and incentives is in line with the strategic supply wheel view on efficiency. The strategic supply wheel was first introduced in 2002 and is shown in Figure 4.

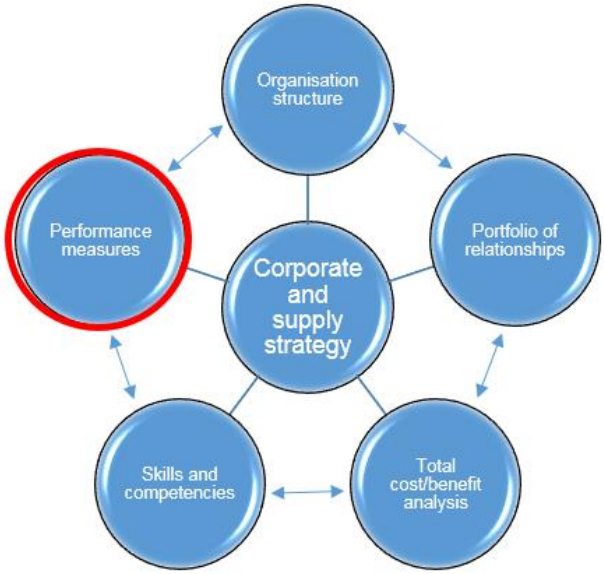


**FIGURE 4 - THE STRATEGIC SUPPLY WHEEL[38]**

Let us now focus on the performance measures element of the wheel. Performance measures are created to translate corporate strategy into clear actions. It starts with a corporate strategy, which is the basis of the supply strategy. The supply strategy is broken down into goals and objectives. These goals and objectives all have their specific and outlined performance measures in place. These performance measures show the current performance of a certain goal or objective against its target or desired state and actions can be defined accordingly. Next to that a clear performance measurement system in place will bring the company other benefits like improved decision making, improved level of communication to the internal customers, and improvement of the visibility of the projects and processes the procurement department is working on. And

[37] See Kulp et al. (2006), p. 211-212.
[38] Source: Cousins et al. (2008), p. 145.

last but not least, as discussed before, performance measure in place will be an incentive for people to act in a compliant way.[39]

There are two important dimensions that relate to organizational performance; efficiency and effectiveness.[40] Efficiency can be seen as the way a firm minimize input for a given level of output.[41] But, "being 'efficient' relates only to using resources in the best possible way for a given organizational strategy".[42] The effectiveness is the effect a certain action has on the performance. An effectiveness measurement can be done by comparing the performance, or success rate, of two comparable data sets, for which one of them an action took place and for the other no action took place.[43] In other words, effectiveness is the influence an action has on the performance. A clear insight in performance asks for a performance measurement system. Such a system can support in the creation of a plan to boost efficiency and effectiveness rates within a company.

### 2.1.3 Wrap up: limiting maverick buying and achieving process control, enabling pooling, and increasing efficiency as requirements for a world class Purchase-to-Pay processes

As discussed in the previous sections, there are a lot of possible reasons that lie beneath performance issues of the purchase-to-pay process. First of all there is maverick buying, the non-compliant purchasing behaviour which shows that a lot of internal customers buy goods and services with non-preferred suppliers, and against contracts for which no upfront procurement agreement was made, or against no contract at all. Last but not least a performance measurement system might help a company to set clear goals and objectives with targets along the way which can increase the performance efficiency and effectiveness rates. Following the issues that might lay beneath performance issues of the Purchase-to-Pay process, the next

[39] See Cousins et al. (2008), p. 147-148.
[40] See Van Weele (1984), p. 37.
[41] See Keh et al. (2006), p. 266.
[42] Achabal et al. (1984), p. 114.
[43] See Wang et al. (2014), p. 163.

section of the literature review will focus on e-procurement and electronic markets as means to improve the Purchase-to-Pay process.

## 2.2 E-procurement and electronic markets as means to improve the Purchase-to-Pay process

### 2.2.1 Evolvement over time shows a shift in scientific literature from innovation, and adoption and barriers, towards e-supply chain modelling, design and implementation, and collaboration issues

Going back in time shows a clear distinction in research focus concerning electronic supply chains. From 2000 onwards the distinction can be made into a focus on innovation, adoption and barriers, and supply chain integration between 2000 and 2006, and a focus on supply chain integration, e-supply chain modelling, design and implementation, and collaboration issues in 2007 onwards.[44] This also shows that in scientific literature a shift is visible concerning e-procurement. A closer look into the topic of e-supply chain modeling / design / implementation, shows that research often takes one of two directions. First is a focus on "e-system architecture, design and implementation; and software development."[45] The other direction focuses on "mathematical modelling and structural analysis of e-supply chain issues."[46]

Although the before mentioned literature shows a focus on the impact across the supply chain, electronical impact in procurement is visible as well. Over the past years, new key trends in procurement and logistics were defined. One of these key trends is e-procurement. E-procurement is a technology solution which is designed to facilitate corporate buying, the buying of goods and services by a corporation, using the Internet as a platform.[47][48] E-procurement exists of several stages, e.g. e-Catalogue, e-Contracting, e-Access, e-Notification, e-Ordering and e-Invoicing.[49] Although e-procurement focuses on one or more stages of the

[44] See Siddiqui & Raza (2015), p. 536.
[45] Siddiqui & Raza (2015), p. 544.
[46] Siddiqui & Raza (2015), p. 544.
[47] See Davile et al. (2003), p. 12.
[48] See Presutti (2003), p. 221.
[49] See Alvarez-Rodriguez et al. (2014), p. 814.

procurement process, it can best "be viewed more broadly as an end-to-end solution that integrates and streamlines may procurement processes throughout the organization."[50] It is argued that online procurement enters a new, more holistic phase, and that e-procurement is the means by which sustainability across the whole supply chain is build.[51]

A positive and significant relationship exists between e-procurement technology usage, and procurement performance and practices.[52] E-procurement is expected to bring benefits to the company. Cost reduction has been seen as the main driver for e-procurement implementation for a long time[53], but streamlining the process, a higher process efficiency, information sharing, and control over maverick spending are also recognized as benefits from e-procurement.[54] This significant relationship shows that e-procurement might play an increasingly important role in the academic literature in the future. In the next section the buying channels within an e-procurement solution are discussed and presented.

### 2.2.2 Electronic catalogues are the most often used buying channels in an e-procurement solution

#### 2.2.2.1 Buying channel evolvement shows a shift from offline channels to online channels

As mentioned before, buying channels are the processes in place for the creation of a purchase order. Buying channel strategy is the strategy that lays underneath the choice for a particular buying channel for the purchase of goods and/or services. A strategy is the high level plan that works as the integrator to create a cohesive whole out of an organization's major goals and actions set.[55] The traditional channels used to purchase goods or services are offline channels. Examples are; going to the physical store of the supplier or placing an order over the phone. Over the last years the online channels started to compete with the offline ones. An example of an online channels is a web shop. The preference of the user community for offline or online channels depends on the stage of the acquisition, which can be information gathering before the

[50] Vaidya et al. (2006), p. 72.
[51] See Dimension Data (2011), p. 5.
[52] See Quesada et al. (2010), p. 526.
[53] See Panda & Sahu (2012), p. 5.
[54] See Parida et al. (2006), p. 2.
[55] See Quinn (1980), p. 14.

purchase, the purchase itself, or post-purchase. This preference is moderated by their experience with the Internet.[56] Furthermore the preference towards a certain channel is influenced by the characteristics of the channel. A channel consists of several attributes, and together these attributes form the uniqueness of a channel.[57] The combination of advantages and disadvantages of a particular channel makes the fit between the channel and the goods or services that are needed. This is also the reason that there is not one channel which is always preferred. To understand and define the desired channel per category of goods and services the characteristics of the goods and services should be investigated. Analysis might be necessary to further explore the behaviour of the purchase of the goods and services in the past.

In the next section types of channels will be discussed in a more in-depth manner. Focus will be on online channels as this research reviews e-procurement solutions.

#### 2.2.2.2 In general there are two types of catalogues, an external catalog which uses an external platform, which is maintained by suppliers, to select products or services there, and an internal catalog, which is hosted within the companies own online environment

Electronic commerce is the use of e-procurement systems in the exchange of products and services. There are two types of such electronic commerce available on the Internet: consumer-oriented electronic commerce and business-to-business electronic commerce. [58]. In light of this research the focus will be on business-to-business electronic commerce. A well-known channel in both consumer-oriented electronic commerce and business-to-business electronic commerce are catalogues. Catalogues are traditionally folders which show an overview of the portfolio of products a firm offers to its customers. An example is a clothing company which creates a catalogue to show their winter seasonal items and print and distribute the catalogue amongst their customers. In short; catalogues are files that contain information about products and/or services a company wants to offer to their internal or external customers. For business-to-business electronic commerce, the catalogue serves as the main channel through which the sales department can communicate information to its customers. The procurement department can

[56] See Frambach et al. (2007), p. 35.
[57] See Hobbs (1996), p. 514.
[58] See Baron et al. (2000), p. 93.

use catalogues as well, to reach their internal customers. The rise of electronic commerce brings along a new type of catalogue; the electronic catalogue. An electronic catalogue is a "World Wide Web based application that provides the company with a new channel to market, sell and support products and services over an open network environment such as the Internet".[59] "Electronic catalogs have become the entry point and as such represent much of what is expected from electronic commerce".[60]

Within procurement the role of customers is fulfilled by internal users of the purchasing tool in place. These internal customers are making use of catalogues to order products and/or services needed on their site or in their office. In general, two types of catalogues exist which are internal and external catalogues. The following example will highlight the major differences between them. Company X acts as starting point. Company X is a wholesaler of candy in the Netherlands. The company has two main options if they want to sell their products through a catalogue solution. The first option is designing an internal catalogue and the second option is offering their products through an external network. It is assumed that company X chooses for the first option. This will then become an overview of their complete portfolio, which can be accessed through the website of the company. An online shop which can only be accessed by their customers with the unique combination of username and password. Company X is responsible for keeping the internal web shop up to date. The catalogue is a static file and is not able to update automatically. This catalogue is often called a 'dumb' catalogue. Dumb refers to the constant effort needed to update the catalogue and the inability to learn and react to users changing needs.[61]

Now it is assumed that company X chooses for the second option: an external catalogue. An external catalogue is visible and maintained outside of the buying tool of the company. The company makes use of a network based catalogue solution. Looking at Amazon.com for example it can be seen that they offer a network or platform to companies to showcase and sell their products by making use of their catalogue tool. The network based web shop like Amazon.com has a wide reach with millions of views each day. The Amazon.com catalogue network is a multivendor catalogue; more than one vendor is represented in the catalogue

[59] Segev et al. (1995), p. 10.
[60] Baron et al. (2000), p. 93.
[61] See Baron et al. (2000), p. 94.

framework.[62] The multivendor catalogue has the ability to perform multi-company cross-catalogue search. However, not every retailer is capable to provide maintenance and storage of all their supplier's catalogues on their server. The so called punch-out catalogue is used as a solution in this case. With a punch-out catalogue the retailer is able to "hyperlink to each manufacturer's catalogue".[63]

An external catalogue has a lot of benefits but how do you get your products and/or services on the platform? Looking at the business-to-business platform of Amazon.com it can be found that the first step is uploading the firm's product inventory onto the Amazon network by using a free desktop software application, XML[64] feeds or text files.[65] After uploading the firm's portfolio potential customers can search for the firm's items.

Next section will discuss the success factors and challenges of the implementation of an e-procurement solution.

### 2.2.3 E-procurement success factors include good change management, performance measurements, and implementation strategy, and challenges include lack of system integration, and end-user resistance

Implementing a business-to-business e-procurement system in a dynamic and innovative organization asks for a clear implementation strategy. There are typically three success factors in such an implementation, namely "supplier and contract management; end-user behaviour and e-procurement business processes; and information and e-procurement infrastructure".[66] Going a bit more in-depth on each of them a group of critical success factors were found in the survey study. These are; end-user uptake and training, change management, re-engineering of the process, system integration, e-procurement implementation strategy, performance measurement, technical standards, supplier adoption, security and authentication, business case

[62] See Keller et al. (1996), p. 1.
[63] Keller et al. (1996), p. 6.
[64] XML stands for extensible Mark-up Language.
[65] See Amazon Services (y.u.), p. n/a.
[66] Angeles & Nath (2007), p. 104.

setting, and top management support.[67] Most of them fit the umbrella of the three success factors mentioned before. For example, end-user uptake and training fit the end-user behaviour success factor, and supplier adoption fits the supplier and contract management success factor.

Besides success factors, challenges can be identified. These so called "challenge-to-implementation factors (CIF)" include a "lack of system integration and standardization issues; immaturity of e-procurement-based market services and end-user resistance; and maverick buying and difficulty in integrating e-commerce with other systems"[68] This partly relates to the issues defined in Chapter 2.1.1 that potentially lie beneath performance issues of a Purchase-to-Pay process.

Another challenge can occur for a hybrid procurement function with both local and global suppliers and internal customers. Reason for this is that there is quite a difference between the implementation processes in a national context and those within a global context. Although not significant, there is some evidence that a different focus on strategies and tools are adopted by companies in Northern America and Western Europe concerning within-continent sourcing.[69] This show that the type of relationship between companies and their local suppliers cannot be globally generalized. Especially in a global operating firm these differences should be taken into account when a global implementation strategy is created. This is an interesting outcome as the company under analysis in this research deals with both global and local suppliers in an e-procurement environment.

An empirical survey analysed current trends in e-procurement and found that reduction of the purchasing price has a very high priority for head of procurement departments. Given the traditional role of procurement this is not a surprise. Internal process optimisation and business-to-business process optimisation are also seen as fairly high to high priority for more than half of the Chief Purchasing Officers that took part in the survey.[70] Optimisation and full integration of the business-to-business process asks for a sophisticated IT infrastructure and awareness on the supplier side. If this is not the case it might be challenging to implement a full integrated

[67] See Vaidya et al. (2006), p. 80.
[68] Angeles & Nath (2007), p. 104.
[69] See Karjalainen & Salmi (2013), p. 120.
[70] See Tanner et al. (2008), p. 10.

relationship between the buyer and seller.[71] Full integration between a firm and its suppliers in terms of electronical commerce is the next step into the future of procurement. To conclude, challenges of e-procurement implementation are, as seen before, not only technical. Change management and the way purchasers perceive the IT infrastructure is critical for successful implementation.[72]

After having discussed possible reasons that might lay beneath the performance issues of the Purchase-to-Pay process and the role that e-procurement and electronic markets might fulfil in means of improvement of the Purchase-to-Pay process it is time to look into the future. The next section of the literature review discusses the Industry 4.0 methodology to outline the possible future state of the Purchase-to-Pay process.

## 2.3 Industry 4.0: from digitalisation to machine-to-machine communication

### 2.3.1 The four industrial revolutions: from steam- and water-powered machinery towards the Industry 4.0 paradigm

A large amount of modern societal transformations can be identified since 1950, from the educational revolution in 1959, the scientific-technological revolution in 1969, the third industrial revolution in 1975 to the information age in 1982.[73] All of these societal transformations show that societies and economies are dynamic and subject to change. Several technological changes have been identified which have highly impacted business life and the economy as a whole. Each of these changes mark the start of an industrial revolution. Revolutions our economy and society have been through recently are the first industrial revolution, where steam- and water-powered machinery was introduced by the end of the 18$^{th}$ century. The second industrial revolution was at the beginning of the 20$^{th}$ century, where division of labour and mass production was introduced with the first assembly line in 1870. The third industrial revolution, where automation by means of programmable logic controllers was

[71] See Tanner et al. (2008), p. 11.
[72] See Kim & Shunk (2004), p. 162.
[73] See Beniger (2009), p. 5.

introduced in manufacturing during the 1970s[74][75]. Now it is said that our society is at the start of a fourth wave of revolution. The internet revolution in manufacturing, often called 'Industry 4.0 paradigm'[76] has become a hot topic, not only in scientific research but also in practice. Especially in Germany, where recognizing the potentials of Industry 4.0 is driven by politics[77] and research, companies provide first solutions on embedding the Industry 4.0 philosophy within their company structure and making it part of their identity[78]. In Switzerland more than 50 manufacturing companies took part in a study on Industry 4.0 and its challenges and solutions for the digital transformation and use of exponential technologies[79]. The combination of "digitally networked and data-intensive are the main attributes to a smarter production, the so called Industry 4.0"[80] People, machinery, products and processes will be more and more connected through electronics.[81] This 'Internet of Everything' makes control mechanisms necessary to keep control over processes and systems as being and staying connected to everyone and everything is key in joining the Industry 4.0 revolution. Following this need of control a new management control model is defined, the CRTA. CRTA stands for Connect, Respond, Trust, and Accelerate.[82] Ownership of each step of the process is necessary to make sure the firm is ready and able to move towards an industry which thrives through connection and technology.

Next part of this chapter will discuss the Industry 4.0 paradigm in more detail and will focus on the concepts of cyber-physical systems and machine-to-machine communication.

[74] See Deloitte AG (2015), p. 3.
[75] See Brettel et al. (2014), p. 37.
[76] See Agarwal & Brem (2015), p. 197.
[77] Industry 4.0 was introduced by the German government as a strategic initiative which pas part of the "High-Tech Strategy 2020 Action Plan" published in 2011. See Kagermann et al. (2013), p. 77.
[78] See Weyer et al. (2015), p. 580.
[79] See Deloitte AG (2015), p. 1.
[80] See Bauer et al. (2015), p. 417.
[81] See Blommaert & van den Broek (2016), p. 2.
[82] See Blommaert & van de Broek (2016), p. 7-8.

## 2.3.2 Anatomy of the fourth industrial revolution: cyber-physical systems and machine-to-machine communication

### 2.3.2.1 Cyber-physical systems merge the physical world with the digital world

Cyber-physical systems (hereinafter referred to as CPSs) are systems "which have a tight coupling between the digital and physical worlds and comprises sensors which measure, and actuators which affect, process in the physical world"[83]. With the before mentioned shift towards digital networks and the internet as a whole it is no surprise that cyber-physical systems gain more and more attention in both literature and practice. CPSs are different from the embedded systems currently used in business. Characteristics of CPSs are the following: closely integrated, cyber capability in every physical component and resource-constrained, networked at multiple and extreme scales, complex at multiple temporal and spatial scales, dynamically reorganizing and/or reconfiguring, high degrees of automation by means of control loops and operation must be dependable.[84] They form the next step in terms of integration and alignment between physical and cyber. The cyber-physical system requires three levels to be intertwined in order to work accordingly; the physical object, data models of the physical objects and services based on the available data.[85] First level, the physical object itself can be a machine in the surgery room. Second level, data models in a network infrastructure, might be patients' data. Third level, services based on the data, might be that the machine gives a warning when a value above X is measured. Combined this will give the following example of a cyber-physical system: "During a surgical operation, context information such as sensitivity to certain drugs will be automatically routed to relevant devices (…) surgical procedures will be correlated with streams of imaging data; streams will be selected and displayed, in the appropriate format in real-time, to medical personnel according to their needs."[86]

[83] Tham & Luo (2013), p. 773.
[84] See Shi et al. (2011), p. 1.
[85] See Drath & Horch (2014), p. 57.
[86] Sha et al. (2009), p. 11.

#### 2.3.2.2 Machine-to-machine communication removes the physical intervention and enables fully-automated communicated from one device to another

An important part of the Industry 4.0 philosophy is machine-to-machine communication. Machine-to-machine communication is the fully-automated communication from one device to another. Important to note is that human intervention does not play a role in the communication process.[87] The devices that take part in this type of communication are called Machine-Type Devices (or MTD) and they form the key of the Industry 4.0 and other paradigms.[88] Machine-to-machine communication is already visible in sectors like healthcare and smart home technologies. A big growth potential in the machine-to-machine market is the Smart Grid. The smart grid is the next generation of today's electricity grid and is expected to be both self-healing and rapidly recovering from system deviations.[89] Smart grid bring together communication capabilities with the generation of gas, water, electric power or other utilities in such a way that automated monitoring and control are in place.[90] ".. Smart meters are expected not to require human intervention in characterizing power requirements and energy distribution."[91] Examples of other typical use cases for machine-to-machine communications are lighting, vending machine control, digital photo frames and enhanced navigation.[92] Several technological challenges exist for the implementation of full machine-to-machine communications. One of them is the possible overload of the base stations when a high number of machine-to-machine devices are trying to access them, which can cause for delays in access and an increase in failure rate.[93]

[87] Biral et al. (2015), p. 1.
[88] See Biral et al. (2015), p. 2.
[89] See Farhangi (2010), p. 19.
[90] See Wu et al. (2011), p. 37.
[91] Fadlullah et al. (2011), p. 60.
[92] See Wu et al. (2011), p. 38.
[93] See Biral et al, (2015), p. 6.

### 2.3.3 Wrap up: practical implications of Industry 4.0 in procurement

Most of the Industry 4.0 research is focused on production. But what about purchasing? Will there be changes there as well? And if, how can the new era of a fourth industrial revolution based on cyber-physical systems change the way in which purchasing is done? This section tries to answer these questions.

The advantage of embracing the Industry 4.0 paradigm is three-folded. First of all, as discussed before, the element of machine-to-machine communications is increasing. Especially efficiency and safety rates can majorly benefit from this. Next step is 'predictive maintenance', where machines inform the company that maintenance is needed. This can increase the reliability of the machines as the change of breakdowns decreases. Last but not least Industry 4.0 can be used for customer engagement. By making use of user data, customers can be served in their needs when the need occurs.[94] Although predictive maintenance sounds like a focus on production machinery, a self-fulfilling shelf with first aid materials can fit here as well. If first aid shelfs would work as Machine-Type Devices the following situation can potentially happen; when bandage is taken from the machine, the machine can sent out a request for refilling immediately. There is no need for employees to check the first aid shelf on completeness and no need for purchasing agents to be involved with the purchase. This will change the way-of-work within purchasing and shifts the tasks for purchasing agents from purchase order creation to more strategic tasks focused on buyer-supplier relationships and contract management.

A prerequisite for change is that the environment has all needs in place for the change to happen. Intelligent analytics like big data team up with cyber-physical systems to transform the way factories run and the way factories are lead. Furthermore, a shift towards manufacturing servitization can be seen. The line between the manufacturing industry and services industry becomes blurred. Focus is not only on selling a product anymore. Instead an integrated package of product and service is offered.[95] But, as mentioned before, both society and technology needs to be ready in order for the Industry 4.0 paradigm to become fully integrated in the way the society conducts business and communicates.

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[94] See Bloem et al. (2014), p. 7-9.
[95] See Lee et al. (2014), p. 4-5.

After having discussed possible reasons that might lay beneath the performance issues of the Purchase-to-Pay process, the role e-procurement and electronic markets might fulfil in means of improvement of the Purchase-to-Pay process, and the future impact of the Industry 4.0 paradigm, the next section takes a bit more practical approach. The current available software is analysed to create an overview and benchmark what is available in the market for the company in terms of cloud based solutions. The section starts with a general introduction into cloud computing and the most common types of cloud computing that exists. Next an overview is given of potential suppliers of a cloud based solution and how their business model fits in the overall cloud computing framework.

## 2.4 An analysis of the state of the art of the current available software shows integrated cloud based solutions that enables firms to participate in online networks

### 2.4.1 Typical forms of cloud computing explained shows the advantages and disadvantages of IaaS, PaaS and SaaS

Before discussing the state of the art of available software that fit the increased role of e-procurement and eventually Industry 4.0, cloud computing is discussed. According to the National Institute of Standards and Technology (NIST) cloud computing is "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction".[96] Essential characteristics of cloud computing are on-demand self-service, broad network access, resource pooling, rapid elasticity and measured service.[97]

Often there are three acronyms or service models used when cloud computing is discussed. These are IaaS (Infrastructure as a Service), PaaS (Platform as a Service) and SaaS (Software as a Service). These services are divided by the degree to which a firm has to manage its own

[96] Mell & Grance (2011), p. 2.
[97] See Mell & Grance (2011), p. 2.

Information Technology in the cloud of a vendor of its choice.[98] [99] So each of them offer a different level of control and user flexibility. Traditional Information Technology has certain functionalities and topics which need to be considered and managed. Figure 5 shows these functionalities and topics in the left column. IaaS takes this list as a starting point and 'removes' a few. They are not actually removed but the user is no longer managing them. The vendor managing the server is responsible for these functionalities and topics. An example of a firm operating in the IaaS marketplace is Amazon.com. Potential benefits of a migration to the cloud are the removal of tedious work and the opportunity for organizational growth. Risks involved with cloud migration might be uncertainty with new technology and lack of support and understanding of the solution.[100] Therefore it is important to create a clear communication and implementation plan when implementing an IaaS solution. PaaS is the next step towards complete coverage by the server owner. The user's only responsibility with the Platform as a Service is to manage the applications and data. A disadvantage is that Platform as a Service limits the user to the languages and tools offered by the server provider. Another disadvantage is the risk of vendor lock-in. A customized application build on the platform of provider X is not easy to move to the platform of provider Y. The last step, Software as s Service, is the most transparent. "You just pay for what you use. A SaaS provider typically hosts and manages a given application in their own data center and makes it available to multiple tenants and users over the Web".[101] Examples of Software as a Service are Dropbox, YouTube, Instagram or other services alike. The end-user, an individual for example, does not have to worry about running the software. This person is just making use of the service. Advantages of SaaS are that it is accessible from any computer and it facilitates collaborative working (e.g. Office 365 package). A disadvantage is that it is not always suitable for business use, as business use often needs a certain degree of personalization for the creation of unique and firms-specific designs.

[98] See Zhang et al. (2010), P. 9.
[99] See Rimal et al. (2009), p.45.
[100] See Khajeh-Hosseini et al. (2010), p. 453-454.
[101] Bhardwaj et al. (2010), p. 61.

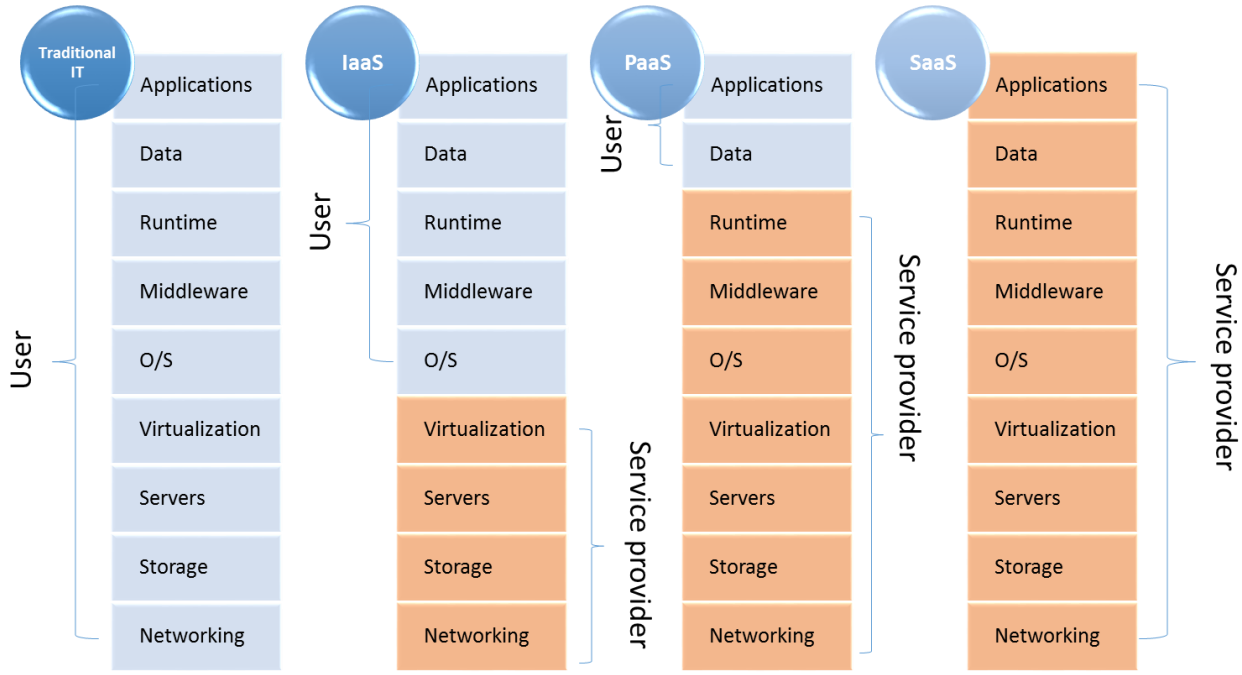


**FIGURE 5 - TRADITIONAL IT, IAAS, PAAS AND SAAS**[102]

The deployment of a cloud solution can be based on four models; through a private cloud, a community cloud, a public cloud or a hybrid cloud.[103][104] A private cloud is an internal data centers of an organization or company which is not shared with the public. A public cloud represents the opposite of a spectrum and is available for the general public on a pay-as-you-go basis.[105] A hybrid cloud is a combination between public and private and the community cloud is a jointly construct and the cloud infrastructure, requirements and policies are shared between organizations.[106]

In the previous section cloud computing in general was discussed. The next two sections will translate this into business use in general and procurement in particular. Let us start with creating an overview of the current available software.

[102] Source: based on Explaining Computers (2010), p. n/a.
[103] See Mell & Grance (2011), p. 3.
[104] See Jadeja & Modi (2012), p. 879.
[105] See Armbrust et al. (2010), p. 51.
[106] See Jadeja & Modi (2012), p. 879.

### 2.4.2 Biggest player in the market of cloud computing is Amazon Web Services, with a market share of approximately 31%

Procurement is subject to change and transformation. In the future it will perform a dual role by looking for new challenges and ideas on the one hand and solving current challenges with creative insight on the other hand.[107] It can therefore be said that ambidexterity will also play an important role in procurement. Ambidexterity is the balance between looking back at the processes that were and are in place, and looking forward to new opportunities, all at the same time.[108] Or in summary, "(…) to explore new opportunities even as they work diligently to exploit existing capabilities".[109]

The previous chapters showed that the biggest challenges or performance issues for a Purchase-to-Pay process are maverick buying, lack of pooling and a lack of efficiency and business control. E-procurement and cloud computing can support a firm in tackling these issues. But when tackling the Purchase-to-Pay process a broader view incorporating end-to-end procurement, or Source-to-Pay, should be taken into account. Strategic procurement decisions and directions should include all steps in the process, from sourcing to payment, to prevent mismanagement, fragmentation and process silos.[110]

Biggest player in the market of cloud computing is Amazon Web Services (AWS). Research showed that Amazon Web Services holds a market share of approximately 31%.[111] "Google, Microsoft, and IBM collectively account for 22%, the next top 20 vendors (Alibaba, CenturyLink, Oracle, etc.) account for 27%."[112] To stay ahead of competition Amazon Web Services signed a partnership with AT&T in October 2016 to jointly develop integrated Internet of Things and "working together on mobility, cloud networking, Internet of Things, analytics and security solutions that are aimed at their joint customers."[113]

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[107] See Deloitte AG (2013), p. 3.
[108] See O'Reilly & Tushman (2004), p. 74 – 75.
[109] O'Reilly & Tushman (2004), p. 74.
[110] See Mitchell (2016), p. n/a.
[111] See Leonard (2016), p. n/a.
[112] Leonard (2016), p. n/a.
[113] Rama (2016), p. n/a.

### 2.4.3 SAP Ariba introduces the Ariba Network: A network based cloud solution that captures the full Purchase-to-Pay process on one cloud platform

#### 2.4.3.1 The Ariba Network brings together over two million unique businesses

As mentioned, a wide variety of firms offer cloud-based solutions. This is not remarkable as there is a solid use case for firms to move to the cloud. Some of them focus on a specifically designed solution for business-to-business services. Others focus on the combination of a business-to-business solution and a business commerce network. One of the frontrunners focused on the power of such a network is SAP Ariba. This U.S.A. based company has offices worldwide and offers Information Technology solutions for the "full range of business-to-business commerce activities and the formation of a supplier network."[114] A key feature of its offerings is the community platform 'The Ariba Network'. At the moment of writing, Q3 2016, there are over two million unique businesses part of this network. They state that simplicity is key and with providing their clients with access to the Ariba Network, the whole process of buying, selling and managing payments is as easy as it would be to use eBay and PayPal.[115]

Ariba offers a variety of solutions in three areas. These areas are; spend & supplier management, financial supply chain management and e-commerce & account management. This research will focus on the first area of expertise; spend & supplier management solutions. The solutions in this area can, when combined together, work as an integrated whole and covers the complete source-to-pay process.

[114] SAP Ariba (y.u. a), p. n/a.
[115] See SAP Ariba (y.u. a), p. n/a.

#### 2.4.3.2 Ariba offers several solutions like guided buying, collaborative requisitioning and spot quote

Examples of the solutions offered solutions are Ariba guided buying, collaborative requisitioning and spot quote. Other solutions focus on the processes involved with spend analysis, strategic sourcing, contract management and more.

Ariba Spot Quote links the Enterprise Resource Planning (or ERP) system of the company to suppliers on the Ariba network that are already doing business with other companies. It is possible to compare quotes of suppliers with whom the company does not conduct business on a regular basis, pick the best offer, and sent the purchasing order back to the company's own ERP system.[116]

Ariba guided buying is a solution focused on user experience. The solution was created based on a four-folded problem statement. First of all, users are confused by too many systems. Secondly users do not always understand the right, or desired, buying process. Thirdly users cannot find the right item easily. Finally, users do not know the preferred suppliers.[117] Goal of the solution is to provide the user of the portal with a user experience that is closely related to their online shopping experiences in their personal lives. Company policies, supplier contracts and other information are integrated in the system. Guided buying blends different catalogue forms to create one place to buy for the end-user community. Guided buying is said to provide "smart guidance to direct users to the right items, preferred suppliers, and compliant policies"[118]. Next to that it can serve as a control mechanism for budget owners, as it can provide clear insights into the purchasing spend. Figure 6 shows what Ariba claims to support with the use of guided buying.

[116] See SAP Ariba (2016c). p. n/a
[117] See SAP Ariba (2016a), p. n/a.
[118] Ariba (2016b), p. n/a.


**FIGURE 6 - GUIDED BUYING SUPPORT FUNCTIONS[119]**

Collaborative requisitioning is another solution provided by Ariba. With collaborative requisitioning, negotiations will partly be done within the boundaries of the Ariba Network. Instead of selecting one supplier to provide the company with a certain product or service, the end-user has the possibility to select more than one supplier. The request for the product and/or service is sent to all the suppliers selected. On their turn, the suppliers can open the request sent by their customer within their own Ariba environment, and if interested they can provide the potential customer with a proposal. The customer can restrain the request to the suppliers by selecting a budget for the product and/or service. In this case, the proposal of the suppliers should not exceed the budget. If more than one supplier proposal is received by the firm, they can compare the proposals and select the supplier with whom they would like to execute the purchase of the product and/or service.[120] This collaborative requisitioning solution can potentially improve the spend control of a purchasing department.

After having discussed scientific literature on potential reasons that lie beneath performance issues, catalogues and a Purchase-to-Pay process, the Industry 4.0 paradigm, cloud computing, next chapter will discuss the methodological approach of this research.

[119] Source: based on SAP Ariba (2016b), p. n/a.
[120] See SAP Ariba (y.u. b), p. n/a/

# 3 A field problem solving project like this research asks for a research design focused on a detailed solution design.

## 3.1 The problem solving cycle serves as the foundation of the methodological approach for this research

The methodological approach, which serves as the foundation of this research, is based on the handbook 'Problem Solving in Organizations' by Van Aken et al. (2012). Two main research paradigms exist. First of all there is the explanatory paradigm, which "aims to produce descriptive and explanatory knowledge."[121] Next to the explanatory paradigm the design science paradigm is proposed, which "aims to produce solutions to field problems..."[122] In relation to these paradigms two basic process structures exist; the empirical cycle and the problem solving cycle.[123]

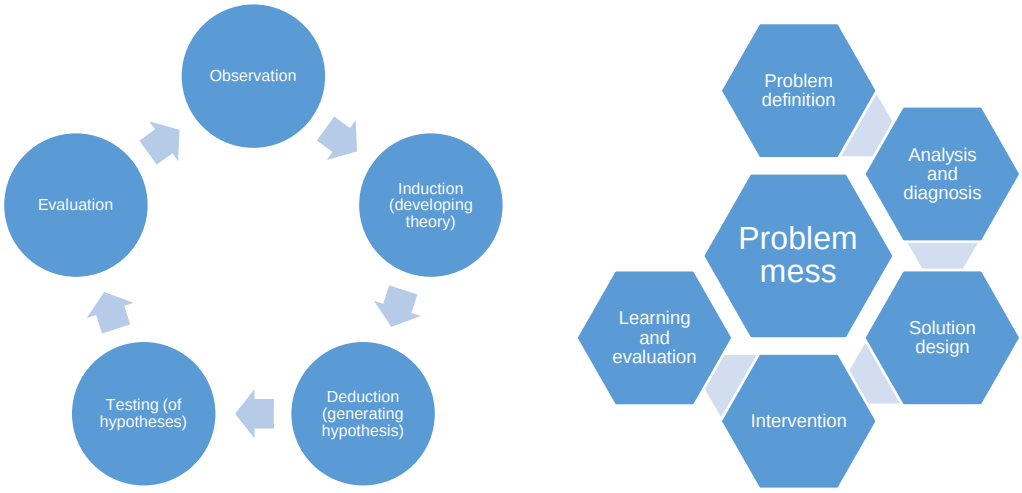



**FIGURE 7 – THE EMPIRICAL CYCLE AND THE PROBLEM SOLVING CYCLE[124]**

Figure 7 shows both of the cycles, the figure on the right represents the problem solving cycle and fits the design science paradigm. The research design of this Master Thesis is based on the problem solving cycle. A problem definition has been provided in the first chapter of this research. Chapter four will analyse the current state of the company and will, if any, map the

[121] Van Aken et al. (2012), p. 9.
[122] Van Aken et al. (2012), p. 9.
[123] Van Aken et al. (2012), p. 11.
[124] Source: based on Van Aken et al (2012), p. 11-12.

gap between current state and desired. Next step proposed in the problem solving cycle is solution design. Chapter five of this research is dedicated to this step. Last two steps, intervention and learning and evaluation, are not part of this Master Thesis due to time constraints. However, it is suggested to include intervention, learning, and evaluation in the implementation steps that might follow the proposal made in this research.

## 3.2 The design process of this field problem solving project shows clear steps from problem analysis to a detailed solution design

This research is a typical example of a field problem solving project. There is a problem and the research question and its sub-questions are focused on finding a solution to this problem, rather than gaining knowledge about the problem itself. Following the problem solving business cycle it is found that the research process of reflective redesign fits best within this research. With reflective redesign "the focus is not simply on a specific business problem of a company, but also on a generic type of business problem".[125] In other words; the proposed solution in chapter five should be valid for other companies as well. The proposed detailed roadmap is highly focused on the company but a high-level roadmap can be used as a baseline for other companies as well.

The design process of the roadmap is based on a general model for a design process proposed by Van Aken et al. (2012), shown in Figure 8. Chapter four analyses the current performance of the company and represents the first step in the process: problem analysis. For the second step in the process, developing requirements, eight concepts were defined which all had an impact on the way the proposed roadmap might be executed and the implementation of the Industry 4.0 paradigm would be reached. These eight concepts form the eight layers that are the basis of the roadmap proposed. Third step, sketching, involved trial and error. Fourth step, outline design, was the development of a high-level roadmap, shown in Figure 16. Detailing is captured in the final roadmap proposed in Figure 17.

[125] Van Aken (2012), p. 15.

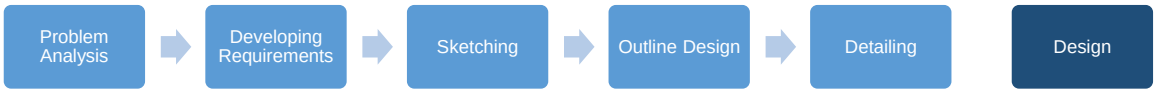



**FIGURE 8 - A GENERAL MODEL FOR A DESIGN PROCESS**[126]

## 3.3 Main deliverable of this research is an extensive solution design of one of the possible solutions for the business problem

Typical deliverables of a field problem solving project are a validation of a selected business problem, an analysis of important causes and consequences, an exploration of potential solutions, an extensive solution design of one of the solutions and a change plan.[127] These deliverables can also be find in this research. The literature review in the second chapter highlights the importance of the Industry 4.0 paradigm. The fourth chapter highlights the consequences of the current way-of-work. The fifth chapter clearly shows an elaborated solution design which might help the company to overcome their current business problem, which is a low performing Purchase-to-Pay process. A change plan is not created separately but flows through the designed projects within the detailed roadmap. Nevertheless, it is critical to take into account the impact of the project on all the stakeholders involved. Van Aken et al. (2012) state that a project like this Master Thesis may come across sources of resistance like lack of understanding, differences in opinion, lack of trust, low willingness to change, and conflicts of interest.[128]

In this research, literature and theory is used as a guiding framework to analyse potential concepts or reasons that lie underneath performance issues of a Purchase-to-Pay process. Furthermore, the literature research showed that there are opportunities within the move to a cloud based solution that the company is going through. Literature as a mean for benchmarking helps the creation of a detailed solution proposal, like the roadmap in the fifth chapter.

[126] Source: based on Van Aken (2012), p. 47.
[127] See Van Aken (2012), p. 82.
[128] See Van Aken (2012), p. 141.

The proposed roadmap is designed to bridge the potential gap between the current state within the firm and the desired end state as provided by literature. A roadmap is seen as an innovative document in which steps needed to reach a goal are identified. A roadmap shows what is needed to go through an innovative curve and reach a desired end-state.[129] Typical examples of a roadmap are the product roadmap, the technology roadmap and the risk roadmap.[130] Often "strategies, product plans and technology plans are created independently by the people responsible for them. Roadmaps explicitly create the linkages."[131] The company strategy is at the heart of the roadmap.

## 3.4 Data is collected and analyzed by means of a literature review, a performance analysis, and based on input from previous data analysis conducted in the past

Data for the literature review was collected through online journal libraries Google Scholar and Scopus. Books and other study materials assigned to courses of the Bachelor International Business Administration and Master Business Administration at the University of Twente were also consulted.

Once the literature review is conducted and the current state is presented it is time for a thorough analysis to see if a potential gap between the current and desired state of the Purchase-to-Pay process exists. And if it does, create guidance to fill this gap as effective and efficient as possible.

Chapter four of this research will analyse the performance of the Purchase-to-Pay process within the company. Performance is measured based on the available data in the spend analysis tooling used within the company, named Helios. Helios provides the raw data on which monthly reports are built within Indirect Materials & Governance procurement. Examples of monthly reports used in the department are the PO compliance Report, the Catalogue Report, the Payment Term Report and the Savings Report. These reports are sent out to the whole Indirect Materials & Governance procurement community. This community exists of around 110 procurement

[129] See Grier (2006), p. 9.
[130] See Albright & Kappel (2003), p. 36-38.
[131] Albright & Kappel (2003), p. 31.

employees. From these 110 employees, around 70 work within one of the clusters defined in chapter 1.2.1. About 20 employees work within the area of global governance projects and systems. Around ten employees represent the markets in which Philips Lighting B.V. is active and the other ten Full Time Employees[132] (hereinafter referred to as FTE) form the maintenance & support team, Philips Support Centre, located in Lodz, Poland. Chapter four provides additional information on the buying channels used within the company. A decision tree is created to serve as a support tool for the creation of a complete list with preferred buying channels per commodities. Input was gathered over the course of one month. Online meetings, email conversations and face-to-face meetings were all part of the process. The performance of the current state is stretched by means of previously conducted user surveys of the current e-procurement solution and data analysis.

Once a clear picture on the current performance is drawn in chapter four, chapter five will focus on the potential gap between current and desired state as part of the field solving problem project.

[132] 1 FTE is one fulltime employee, so in many companies 40 hours of work represents 1 FTE.

# 4 Buying channels and their performance within Indirect Materials & Governance procurement shows a clear need for change

## 4.1 The buying channels used, and preferred buying channels defined, can be different for each of the 62 commodities within Indirect Materials & Governance procurement

### 4.1.1 The buying channels used in Indirect Materials & Governance procurement can be either within the Ariba environment or outside of this platform

To answer sub-question 1a; *'What are the buying channels used within Indirect Materials & Governance procurement?'* gathered data and information is combined to create a list of options for each of the steps in the Purchase-to-Pay process.

The topic of buying channels is not a new concept within the company. Several projects aiming to get insights of the internally used buying channels and the preferred buying channels per commodity were conducted in the past. One of these projects, conducted in 2013, focused on the creation of a channel matrix to put together an overview of the preferred channel for each commodity.[133] However, this research is outdated and the commodities currently in place are partly missing due to changes over time. Another important difference between the study of 2013 and current way of working is that the used buying channels are not the same anymore. With the new Ariba module new channels arose. These possibilities need to be explored and in parallel discussed within the clusters. This overview is updated, verified, and shown in Figure 9.

The first three items: catalogue item, partial item and parametric item, all belong to the buying channel type catalogue. The difference between a traditional punch-out or internal catalogue item and a partial or parametric item is that not all information about the item is given upfront.

[133] See Capgemini Consulting (2013), p. n/a.

It might happen that the requestor still needs to provide the supplier with additional information before the step from purchase request to purchase order can be completed. The choice to adopt the possibilities of partial items and parametric items within the Indirect Materials & Governance procurement department is made due to the fact that some spend categories within the department do not fit the traditional catalogue way of ordering. Examples of these are marketing events or time hire. A kit item is another type of catalogue item. When using a kit item, a requestor can order several catalogue items with just one click. A great example is an employee starter package. This kit item includes a laptop, a mouse, a headset, a phone, and for instance a laptop adapter. The requestor does not need to search and procure each of these items individually. The items are already bundled and offered as a package.

Another possible buying channel is through a simple form. This is an electronic form with pre-defined line items and questions to gather all the required information at the start of the process, to increase the 'first-time-right' or first past yield rate of purchase order processing within the department. A decrease of the order processing cycle times will on its turn improve the efficiency rates.

Additionally, there are a few buying channels that run outside of the Ariba platform. First is the so called third party ordering tool. These are tools that run on their own and have no direct connection to the Ariba solutions and network. An example is Concur, the tool used to book flights and hotels for employees that take business trips. Ariba acquired Concur and is during the time of writing working on a solution to integrate this tool within their network of solutions. Another buying channel outside of the Ariba environment is the use of a purchasing card. At the moment the purchasing card solution of American Express is used within Indirect Materials & Governance procurement. Ariba offers a purchasing card solution of their own but there is no agreement or decision yet on how to integrate the purchasing card with the Ariba solutions and network.

The last possible buying channel is by creating a free-text item in the Ariba solution. As the company wants to increase control over spend and therefore the creation of free-text items is not preferred. However, since the company is not able to provide their internal customers with a purchasing portfolio which is completely covered by means of catalogue items or other tools, the use of the free-text option will be available for the internal customers for the time being.

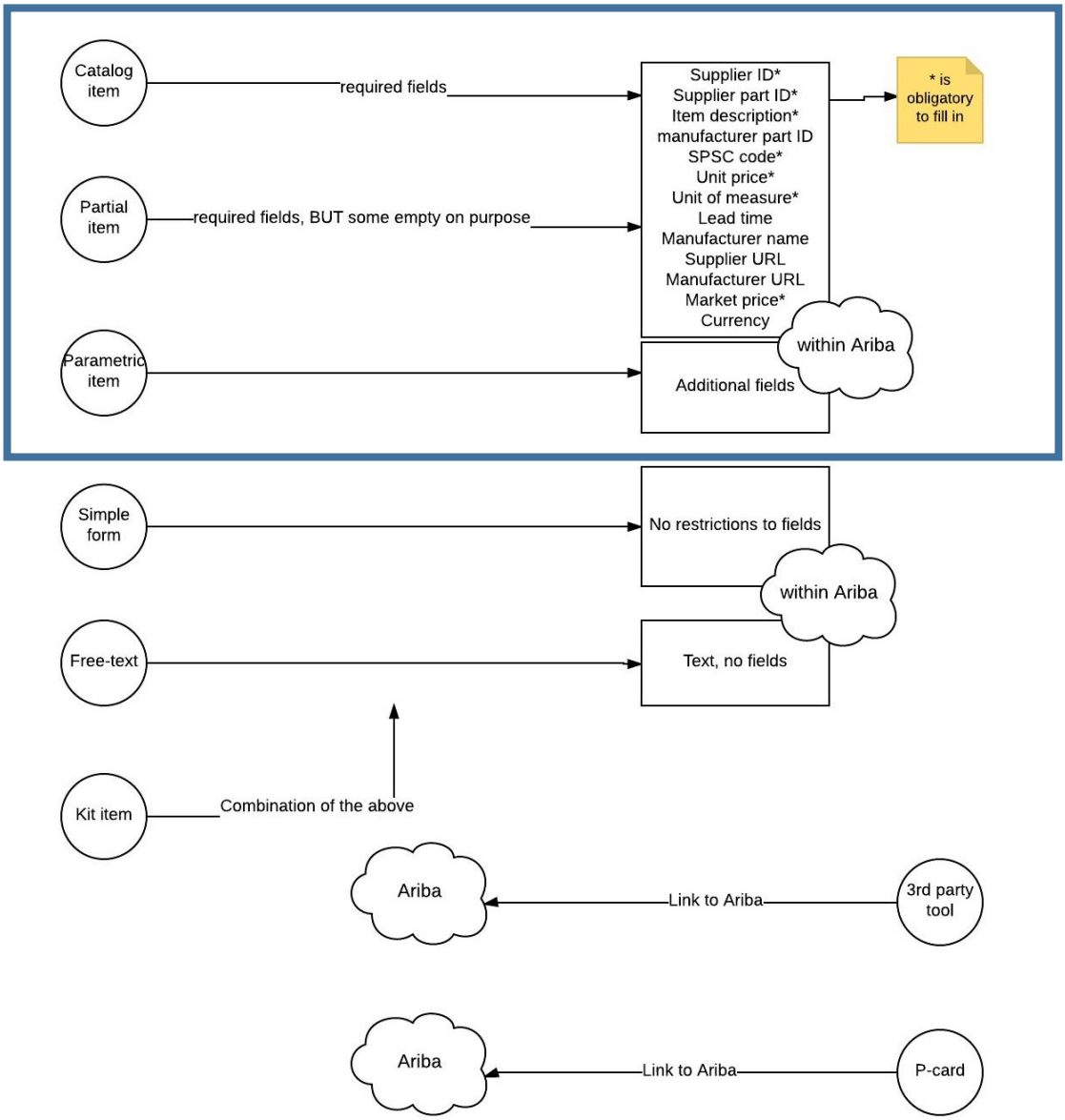



**FIGURE 9 - CHANNEL OVERVIEW INDIRECT MATERIALS & GOVERNANCE PROCUREMENT WITH THE NEW ARIBA SOLUTION**

### 4.1.2 The preferred buying channel is different for each of the 62 commodities within Indirect Materials & Services procurement

Next step is answering sub question 1b; *'How can the preferred buying channels within Indirect Materials & Governance procurement be identified?'* As discussed before, the preferred buying channels might be different for each commodity. As previously mentioned, at the moment there are 62 commodities which can be broken-down into 137 CLOGS codes (Classification of Goods

and Services). At the end of the year 2016 the first phase of changing the taxonomy to United Nations Standard Products and Services Code (UNSPSC) will be implemented. Therefore the channel strategy is done on a commodity level instead of a more in-depth CLOGS level. The commodities will stay intact for the time being.

The choice for this preferred channel is based on discussions between the commodity managers and the catalogue team, in which the author has a seat. This channel strategy will be integrated into the commodity strategy, outlined in the Philips Lighting Expense Management Policy (or PLEMP). The Freight & Distribution cluster is out of scope for this exercise. The clusters and their respective commodities are shown in Appendix 1.

A decision tree to support in the selection of the preferred buying channel is shown in Figure 10.

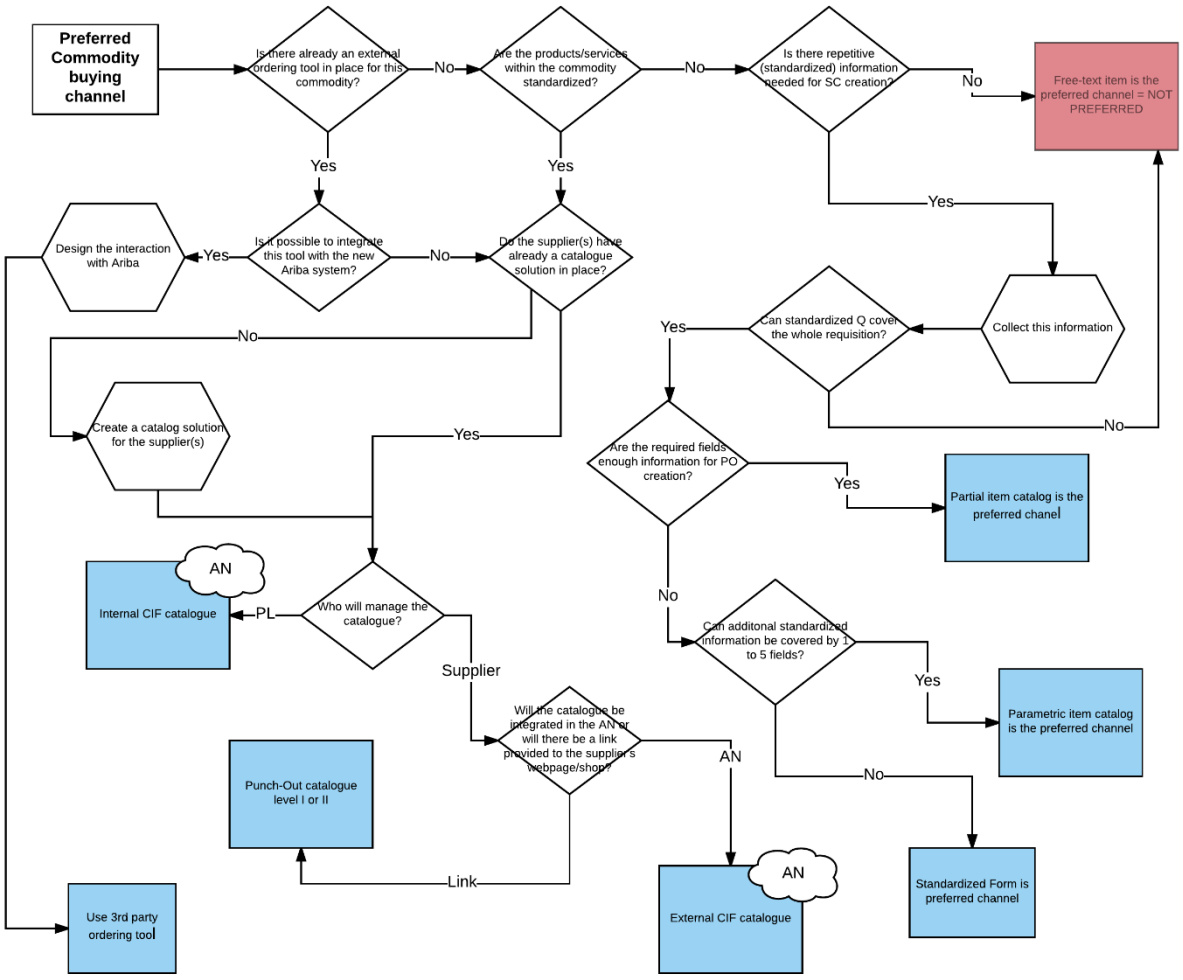



**FIGURE 10 - DECISION TREE PREFERRED COMMODITY BUYING CHANNELS**

## 4.2 Performance of the current channel strategy in relation to the state of the art, found by means of a literature review, shows a need for performance increase

### 4.2.1 Maverick buying and purchase order compliancy rates score below target but an upwards trend is visible

For 2016 the target Key Performance Indicators (or KPIs) for both purchase order (or PO) compliance and SRM compliance was set at >90%. This is according to corporate policy and corporate goals. Table 3 shows the compliancy rates for both purchase order compliance and SRM compliance value- and volume based. Purchase order compliance means that a purchase order is created before engaging in an external commitment. SRM compliance means that not only the purchase is created before engaging in an external commitment, the involvement of the Indirect Materials & Governance procurement department is secured and the purchase is in line with the Rules of Conduct for Indirect Materials & Governance purchasing. Volume based is the compliance based on the number of line items in the transactions.

| **Key Performance Indicator** | **Percentage October 2016** |
|---|---|
| PO compliance – value based | 87%* |
| PO compliance – volume based | 83%* |
| SRM compliance – value based | 82%*[134] |
| SRM compliance – volume based | 93% |

**TABLE 3 – PO AND SRM COMPLIANCY INDIRECT MATERIALS & GOVERNANCE PROCUREMENT OCTOBER 2016[135]**

Although three of the four key performance indicators are not yet met, an upwards trend is visible over the past few months. Figure 11 shows this upwards trend. Note that the steep

[134] * is a rate below target.

[135] Source: based on Internal Monthly Compliance Report Indirect Materials & Governance, Philips Lighting (October 2016).

increase from March to April is mainly influenced by excluding parts of the total spend from the PO compliancy targets. The most important trend upwards can be seen from July onwards.

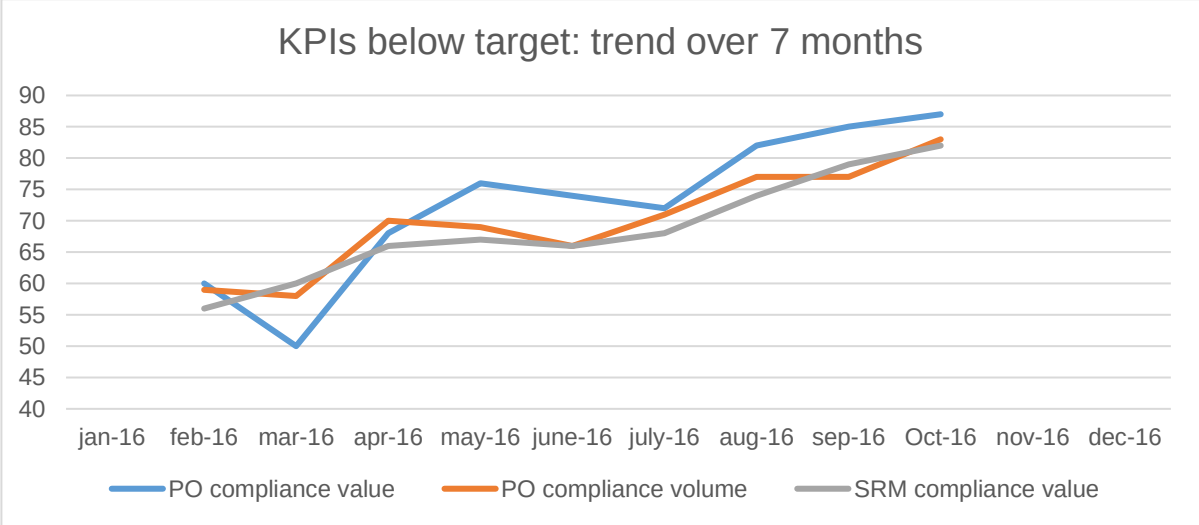



**FIGURE 11 – TREND FROM FEBRUARY 2016 TILL OCTOBER 2016 FOR COMPLIANCY KPIS BELOW TARGET[136]**

### 4.2.2 Supply base optimization is a required step before a pooling of demand strategy can be beneficial

In this section the second sub question is discussed; *to what extent differs the preferred supplier base from the supply base used within IMG procurement?*

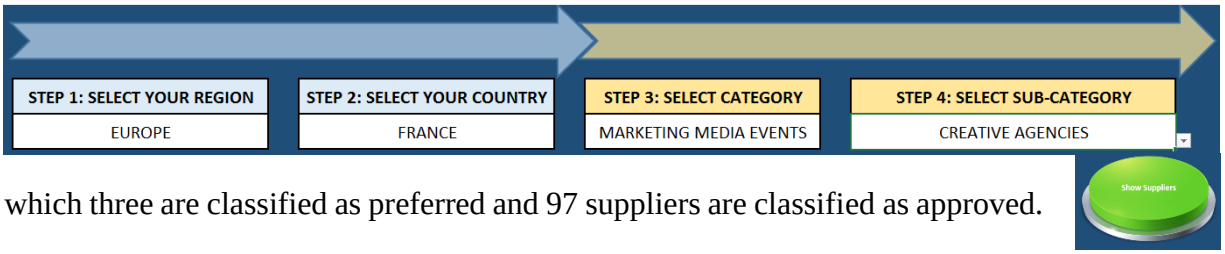
Literature showed that pooling can potentially support the strategy of exploitation of buying power. A clear overview of the supply base and the division of these suppliers into quadrants can help identifying opportunities for a pooling strategy as it provides the firm with characteristics for each quadrant. The suppliers can be divided based on the products or services they provide to the firm.

Within the department a highly fragmented supply base makes it difficult for the commodity managers to focus on their most important suppliers. Managing the total supply base is a time consuming job. At the moment there is not a total list of suppliers which includes all the suppliers that the Indirect Materials & Governance procurement department is engaged with.

[136] Source: based on internal monthly compliance report Indirect Materials & Governance, Philips Lighting (September 2016).

The supply base is rather scattered and therefore the department has some difficulties with controlling its supply base. The creation of an approved supplier list tried to increase this control. This list was creation over the course of a few months and internally published by November 2016. This Approved Supplier List (hereinafter referred to as ASL) has a couple of benefits for both requesters and the Indirect Materials & Governance procurement department. First of all it might reduce sourcing cycle times on requestor side, as it supports with creation 'first time right' purchase requests. Second it stimulate requestors awareness on the supply base and thirdly the firm can benefit from better rates and service levels if contracted suppliers are used. For the procurement department it can increase policy compliance, strengthen the procurement early involvement in the process, the list can potentially feed the Ariba Purchase-to-Order solution and it create better leverage for procurement through the use of preferred suppliers. This last potential benefit can be seen as a pooling strategy.

All of these benefits sound promising but the Approved Supplier List internally published in November 2016 was not mature enough to bring these benefits to life. The scattered supply base is consolidated into one to provide guidance to both requesters and approvers in the Purchase-to-Order process, which is covering the steps of the Purchase-to-Pay process until the accounts payable part, but this consolidation is not a supply base optimization. Usage of this file shows this difference clearly. As an example the author used the start page, which is shown in Figure 12, to search for creative agencies suppliers in France. The result is a list of 100 suppliers, of




which three are classified as preferred and 97 suppliers are classified as approved.

Three preferred suppliers are reasonable and help the requesters to choose a supplier for their request. However, the presence of 97 approved suppliers tells the requesters that it is ok to use one of these 97 suppliers as well. The Indirect Materials & Governance procurement department does not want to support this usage. Another example, a search in the category Information

**FIGURE 12 - START PAGE APPROVED SUPPLIER LIST (ASL) (INTERNAL DOCUMENTATION)**

Technology and sub-category Hardware, provides a list of 294 approved suppliers. This makes it very difficult for requesters to choose. Optimizing the scattered supply base might support in fully benefitting from the pooling of demand strategy.

### 4.2.3 The Purchase-to-Pay process shows an inefficient way-of-work with a net promoter score of -28, non-compliant behaviour and no clear mechanisms, systems and incentives to ensure compliance

Having the right combination of people, process and technology in place can potentially generate maximum result in terms of efficiency. Improving the purchasing efficiency goes through a 3-phase approach. Phase 1: gather data to identify key areas of noncompliance. Phase 2: identify the causes of noncompliance. Phase 3: design mechanisms, systems and incentives to ensure compliance. [137]

As mentioned before, the amount of data, number of interactions, different departments involved in the process and links with external parties makes the Purchase-to-Pay process complex and consequently difficult to control. An overall end-to-end solution covering technological issues and processes, organizational aspects, people and processes in general can help to control the Purchase-to-Pay process. For such an end-to-end solution to show the ability

[137] See Kulp et al. (2006), p. 211-212.

as designed, it might be helpful to look at the current state of the purchasing efficiency. Electronic integration, as outlined in Figure 13, goes through four stages: Basic, Intermediate, Advanced and Fully Integrated. The first stage, basic, shows only a small amount of integration. The Electronic Environment is not yet optimally used. The second stage, intermediate, already shows an increase in value and a decrease in costs. Using catalogues for Business-to-Business ordering is a commonly used way of e-procurement in this stage. The third stage, advanced, is automating the exchange of information and value transcends costs. The fourth and last stage is completely "touchless". There is full automation in the procurement process, from sourcing to payment.[138]

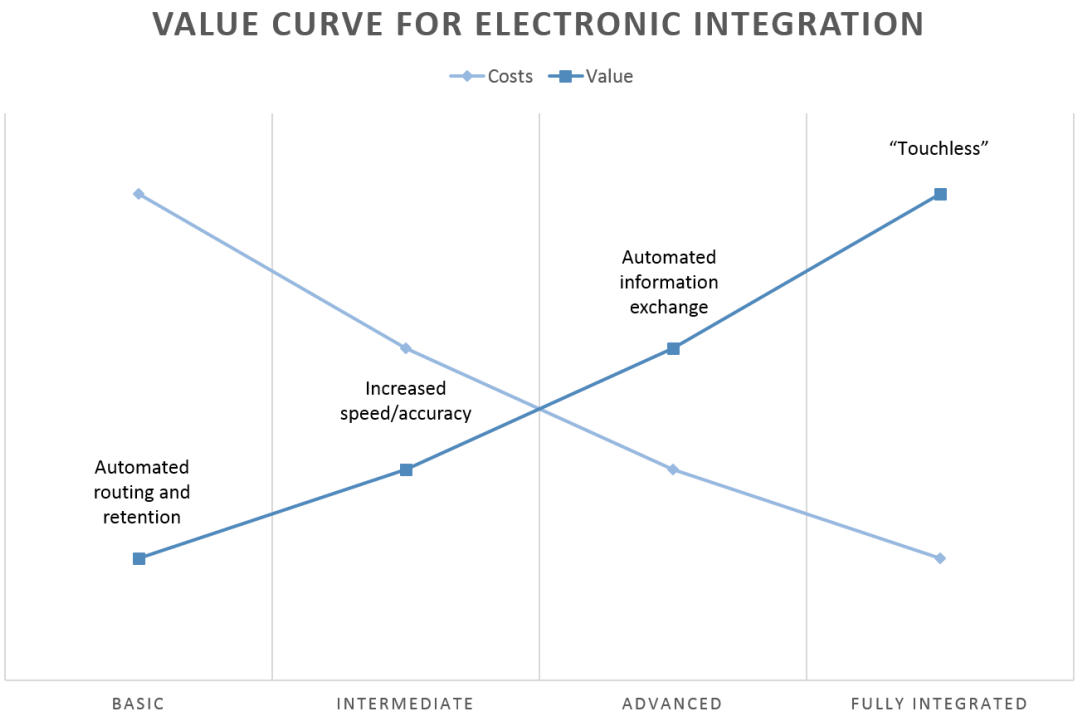



**FIGURE 13 - VALUE CURVE FOR ELECTRONIC INTEGRATION[139]**

The first pass yield score, the amount of purchasing requests that do not require any re-work for the external transactional service centre and can be approved directly, is 40%.[140] Reasons are often missing information or wrong information. Consequence is that certain amounts of iterations are required between the requester and the person who is completing the request before ordering. This increases the cycle times. A clear and structured way of creation a purchase

[138] See IBM Digital Sales (2016), p. 8.
[139] Source: based on IBM Digital Sales (2016), p. 8.
[140] Internal Reporting.

request might increase the first pass yield rate and supports the internal user community in ordering in a correct and ‘first-time-right’ way.

The Net Promotor Score (NPS), given by a sample of internal users of the current SRM tool, was -28% halfway 2015. The NPS can be between -100% and +100% and shows how likely a person is to promote, detract or act neutral about a certain topic. A score of -28% on the topic of ease-of-use of the current SRM tool shows that the user community is dissatisfied with the current way-of-work. This score is an important contributor to the decision to leave the current tool and change the way-of-work within the Indirect Materials & Governance procurement department majorly.

Based on Figure 13 Philips Lighting Indirect Materials & Governance procurement current state can be scaled in the first stage of the electronic integration value curve, basic. Improving the purchasing efficiency goes through a three-phase approach.

### 4.2.4 Wrap-up: current way-of-work within the Indirect Materials & Governance procurement department shows a need for standardization and clear designed steps moving forward

The current state of the performance of the Indirect Materials & Governance procurement department is at a lower level than the company in general and the management team in specific is aiming for. Figure 14 shows the current state of the Purchase-to-Pay process. It can be seen that five departments or groups are involved with the steps from specifying a need towards invoice management. First group, business users & approvers, are the user community of about 4.000 internal users and the approvers that are part of the approval flow as defined upfront. These approvers can be for example colleagues from the Finance department to approve budget. Second group, business requesters, are the people that actually create a request in the system. The third group; TSC order desk, is the outsourced third party who is responsible for completion of the shopping carts created by internal customers. The TSC order desk support in administrative tasks. The fourth group; the IMG procurement department, is responsible for the creation of buying instructions, providing the user community with a clear overview of approved and preferred suppliers, and sourcing approval. The fifth group; TSC account payable, handles

the administrative tasks involved with invoice management. This group is an outsourced external party as well. Figure 14 shows clearly that specification of the need, sourcing and quotation and agreement with the suppliers happens many times outside of the ordering tool. The current ordering tool, SRM, is only consulted for the creation of a shopping cart, which might be after-the-fact as discussed before.

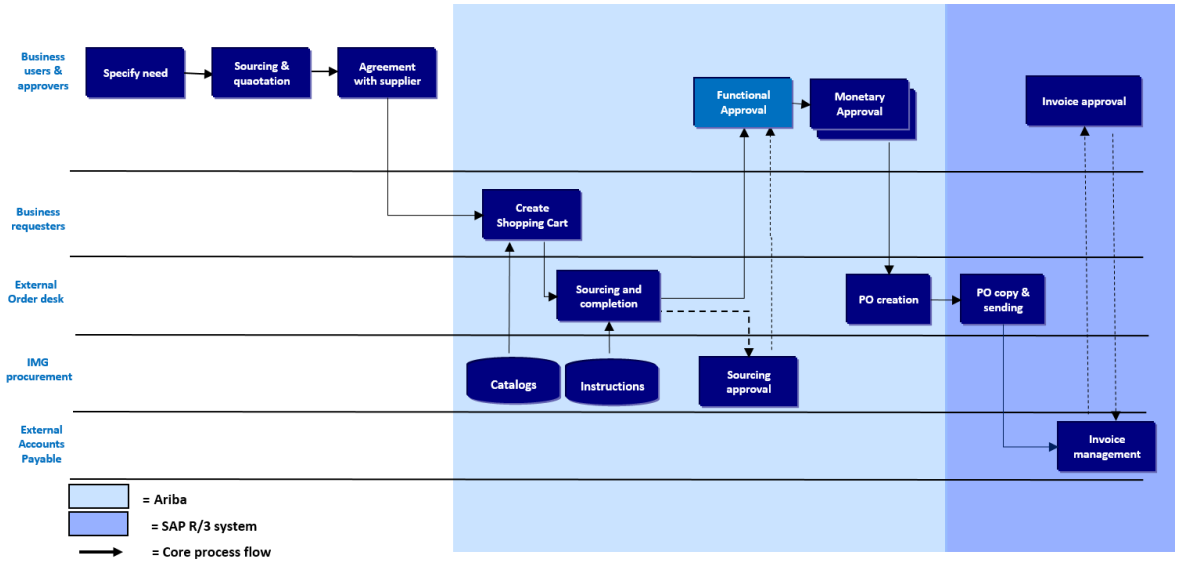



**FIGURE 14 - CURRENT PURCHASE-TO-PAY PROCESS IN INDIRECT MATERIALS & GOVERNANCE PROCUREMENT (INTERNAL DOCUMENTATION)**

Furthermore, Figure 14 shows clearly that part of the process takes place outside of the procurement system or SRM tool. Specifying the need of the business, sourcing and quotation, and even agreements with suppliers are made before a purchase request is created in the procurement system. Too often a Request-for-Information or Request-for-Proposal is requested by the end-user community at suppliers, before entering the procurement system. A consequence of negotiations and discussions done by the end-user community, without any involved of the Indirect Materials & Governance procurement department, might be that non-preferred suppliers are contacted and, worse, contracted for a certain product or service. As the end-user community is not fully aware of the commodity level strategies and the reasons why certain suppliers are classified as non-preferred, they might show non-compliant behaviour without understanding what they do wrong. A possible solution for this issue is the implementation of Ariba collaborative requisitioning. This solution, shortly introduced in Chapter 2.4.3.2, takes the process of Request-for-Information and Request-for-Proposal

gathering within the boundaries of the Ariba Network. The end-user community will keep the possibility to compare several suppliers for a certain project, service or product, but can only choose from suppliers approved by the procurement department and are visible in the procurement system to choose from. Non-preferred suppliers will not be shown in the new Ariba portal of the company and this might make the usage of approved, and even better preferred suppliers, easier than non-preferred suppliers.

# 5 Roadmap design as a solution for filling the gap between current state and state of the art

## 5.1 Desired state of buying channel and supplier usage within Purchase-to-Pay shows an integration into one point of entry for the end-user

This chapter tries to answer sub question 3a: *How to ensure that the preferred suppliers are used by the end-user?* And sub question 3b: *How to ensure that the preferred buying channels are used by the end-user?*

Currently the state and performance of the Purchase-to-Pay process are defined as the time to create a plan to close the gap between this current state and the state of the art available. The literature review and analysis of the current performance showed that the user community is in need of guidance, support and a clear communication plan on the desired way-of-work. They have to understand what the procurement department needs from them, in order to meet that need.

The extensive range of customized solutions used in the commodities at the moment makes it almost impossible to get a clear view of the processes involved. A solution might be for reports to show a minimal deviation in reflecting the correct numbers and figures, and for measurement systems to run smooth, standardization might be a solution. Over the last decade a lot of tools were implemented as a reaction and possible solutions to a lack of spend control. Implementation of such tools was mainly done on commodity level. All of these tools are now embedded in the way-of-work and make it hard to compare the results and get a clear performance indication. Following the company strategy, it was decided that the implementation of a new e-procurement cloud solution might be used to return to the core tasks and responsibilities of the Indirect Materials & Governance procurement department. In other words; creating one way-of-work moving forward and providing the internal user community with clear guidance and a structured overview on where to buy, what to buy and how to buy.

Figure 15 shows the possible answer on sub questions 3a and 3b and provides a desired end state for the Purchase-to-Order process. The Purchase-to-Order process differs from the Purchase-to-Pay process in that it does not take into account the payment and invoice management of the goods or services ordered.

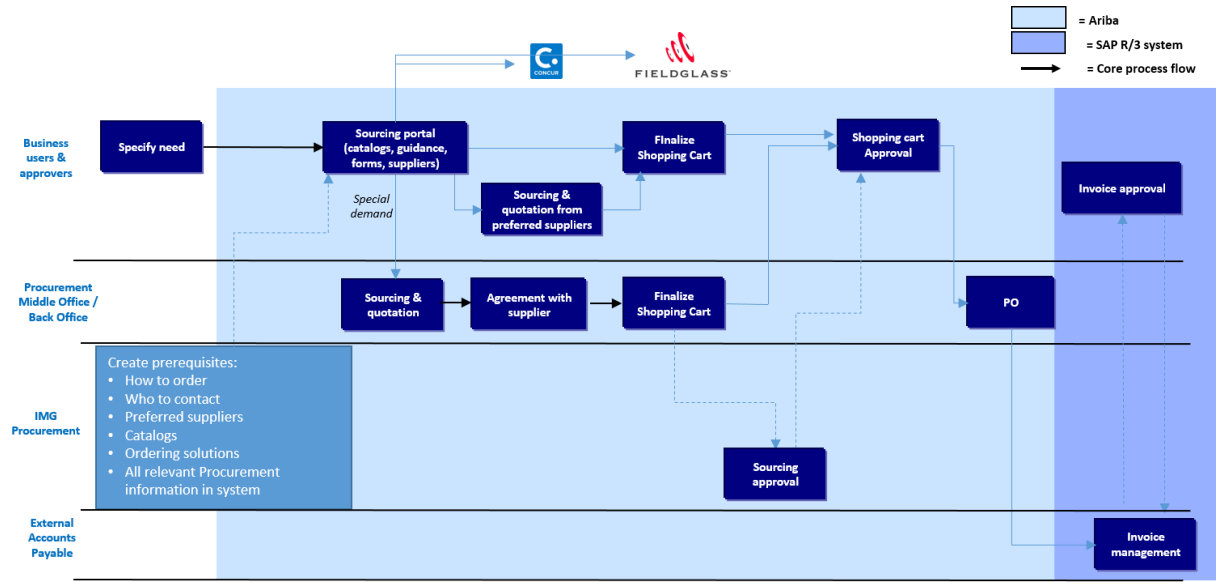



**FIGURE 15 - DESIRED END STATE PURCHASE-TO-PAY PROCESS IN INDIRECT MATERIALS & GOVERNANCE PROCUREMENT (INTERNAL DOCUMENTATION)**

Figure 15 differs from Figure 14 due to the fact that it brings back the groups involved in the process from five to four. The business users and approvers are still an important part of the process, but the TSC order desk is replaced by an internal procurement middle- and back office. This middle office and back office will be responsible for sourcing & quotation, closing agreements with suppliers, finalizing the shopping carts (purchasing requests) and sending these purchase requests for approval to their Indirect Materials & Governance procurement employees and potential other approvers assigned. Once approval has given the middle office and back office finalizes the purchase order and sent it through to the supplier. Once the product or service is delivered and an invoice is received the TSC Account Payable team will manage the invoice to make sure the correct invoice approvals are gathered and the invoice will be paid.

Biggest difference from the current state is that the requesters, so the user community of over 4000 internal users, are guided to the Ariba tool in an early stage of the process. This process is possible with the Ariba solution Guided Buying. Guided Buying, as discussed before, is a solution that can guide users through the process of ordering. After identifying a need the requester will already enter the Ariba tool. This can ensure the usage of preferred suppliers and

preferred buying channels. Reason for this is that the Ariba tool can potentially act as a 'landing page' for the requester. From this 'landing page' the requester can only make use of the options that are there. Besides the Ariba catalogue options for ordering links towards the third party ordering tools like Concur (a tool through which hotels and flight tickets can be booked) and Fieldglass (a human resource tool) should be visible on the 'landing page' as well. By doing so, maverick buying might be discouraged.

Figure 15 also shows that there are a number of prerequisites in order for this desired end state to run smooth. First of all there should be a clearly defined document or training on how to order through the Ariba platform. The user community should be trained, supported and enabled to take full ownership of the desired way-of-work. The quality of the training received to be able to work with the solution is one of the key elements in user acceptance.[141] As a lot of technical changes are happening this topic might be overshadowed, but change management is key for this end state to be reached. The next prerequisite; who to contact, is also part of the change management and communication process. All stakeholders that are part of this journey or are affected by the changes ahead should know who to reach out to in case of questions. The different stakeholders involved can provide useful and necessary feedback from the perspective of their areas of expertise.

Next prerequisite is an overview of the preferred suppliers. As discussed before, the preferred suppliers should be known to the user community in order to embed the usage of them in the daily way-of-work. Other prerequisites are catalogues and other ordering solutions. The quality of the content on the system is another key element of user acceptance and usage of the tool.[142]

The next section of this paper will provide a roadmap to bridge the gap to move from the current state to the desired end state just discussed. This roadmap might be a solution, however it is important to note that each case is different and the roadmap that potentially fit the way-of-work at Philips Lighting BV might not fit into the processes and systems of another company.

[141] See Brandon-Jones & Carey (2011), p. 277-279.
[142] See Brandon-Jones & Carey (2011), p. 277-279.

## 5.2 First steps into the fourth industrial revolution: a roadmap from standardization, through integration and automation, into machine-to-machine communication

### 5.2.1 A high level overview of a roadmap shows the key focus points that serves as the foundation for a detailed roadmap

Figure 16 provides a high level overview of the roadmap design from 2017 to 2021 onwards. The first step towards the fourth industrial revolution is focused on standardization. Standardization of the processes, the way-of-work, and the strategies of each of the commodities. It is proposed that the company might benefit from a standardized way-of-work in terms of purchase request creation, guidance, support, etc. Next step towards the Industry 4.0 paradigm is integration. Integration not only between the commodities but also between departments. Integrating the processes and systems end-to-end, so with inclusion of sourcing on the one side and finance and payment on the other side, can create a clear structure and basis for further systems innovation. The third step is automation. Automation means that no human intervention is necessary in transactional tasks, like for example purchase order completion. Completion of purchase orders or invoice sending is automatically done. Last step, which let the company enter the Industry 4.0 paradigm, is machine-to-machine communication as the next level of automation.

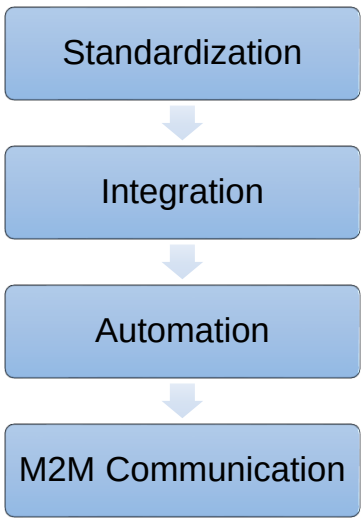



**FIGURE 16 - HIGH LEVEL ROADMAP FROM 2017 TILL 2021 ONWARDS**

Figure 17 shows the roadmap specifically designed for the company in field problem solving project. The roadmap exists of several layers or topics which influence each other and combined form the basis for Purchase-to-Pay performance improvement steps within the company. The eight parts, or layers, of the roadmap are; process standardization, item taxonomy, closing the loop, reporting, from Purchase-to-Order to Purchase-to-Pay, supplier management, procurement strategy, and buying channels. All of these topics have their own challenges and opportunities, which combined can open the way forward. In the next section, each layer of the roadmap will be discussed in further detail.

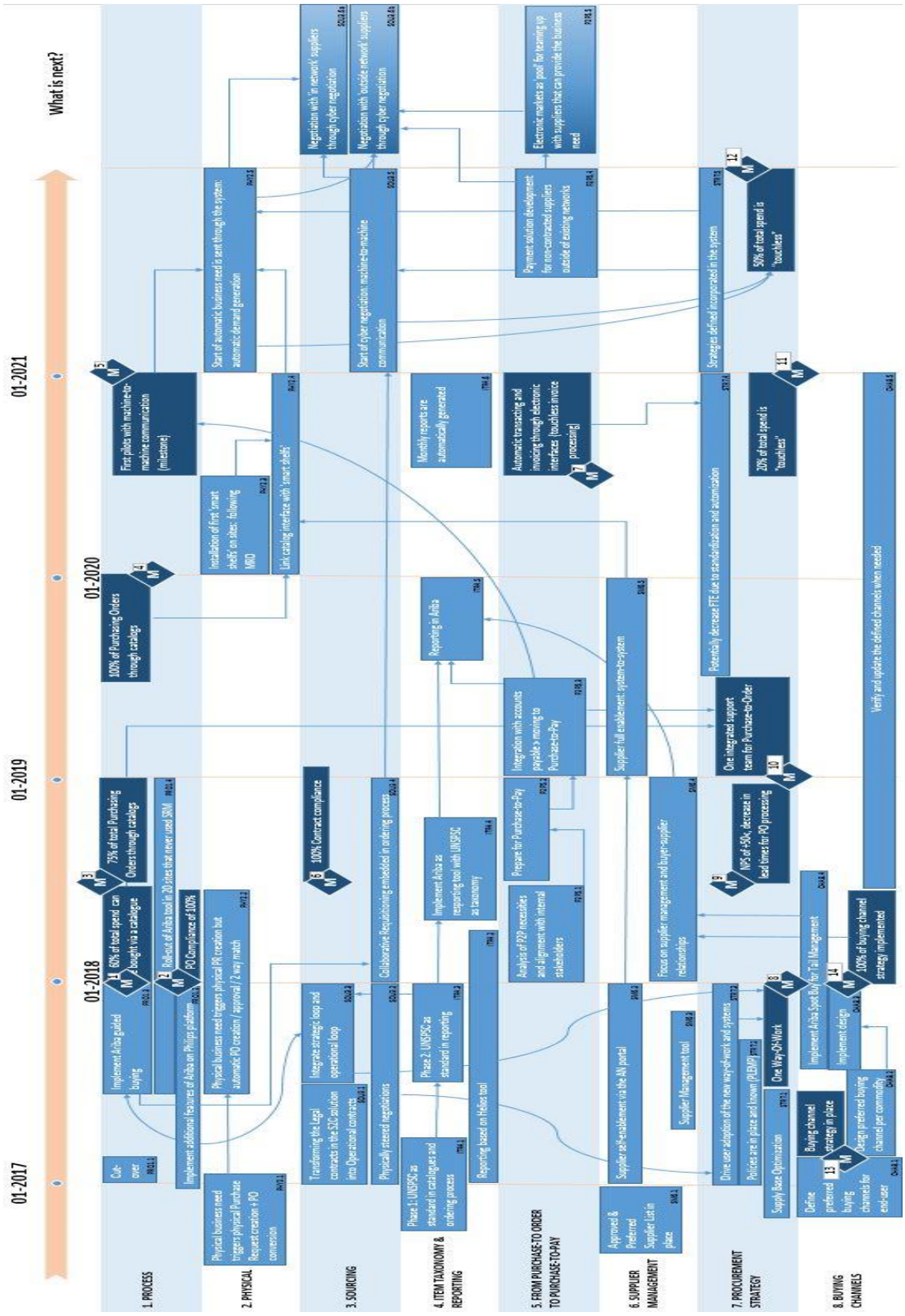



**FIGURE 17 – DETAILED ROADMAP FROM 2017 TILL 2021 ONWARDS**

### 5.2.2 Process standardization by means of catalogue creation and guided buying implementation

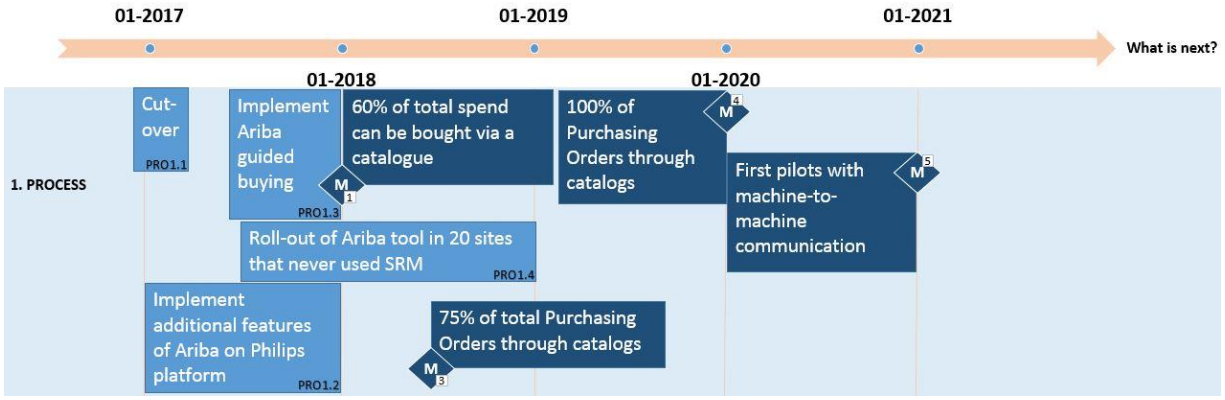



**FIGURE 18 - PROCESS PART OF THE PROPOSED ROADMAP**

The process standardization layer of the roadmap, shown in Figure 18, is focused on the ordering process and buying channels. The first topic, the cut-over of the current SRM tool into the SAP Ariba platform, is about the short time-span of about one month (January 2017) in which the two tools are running side-to-side (PRO1.1). It will be possible for the internal user community of over 4.000 people to create a purchase request in the old system SRM. Till the end of the month it is possible for approvers to approve the purchase requests in the old system and in parallel the external operational support team can complete purchase requests in the old system. However, users are advised to start using the new SAP Ariba cloud environment as soon as possible to get used to the system and ask for support and guidance if needed. As of the 1st of February, 2017, the Ariba cloud solution will be the only e-procurement tool in place to work with.

Throughout the full year 2017 focus will be on the implementation of the additional features that the Ariba solution can bring (PRO1.2). These are mainly the catalogue types as discussed in Chapter 4.1.1. Halfway through the year a next phase will start with the implementation of guided buying, an Ariba solution which will go live globally in the fourth quarter of 2016 (PRO1.3). In parallel the roll-out of the Ariba tool in the remaining sites, the sites that never used SRM in the past and are allocated to a second wave of implementation, will be started (PRO1.4). Milestones set at the end of the year 2017 are a Purchase Order compliancy rate of 100% and a possible spend coverage of 60% in terms of catalogue buying. This means that, when the catalogue usage is 100%, 60% of total spend will be bought via a catalogue solution.

Halfway through the year 2018 another milestone is set at 75% of total purchasing orders that flow through catalogues. This milestone is following the previous milestone of 60% of possible spend coverage. 75% of the total spend, year to date, should be bought via a type of catalogue solution. This also means that the total amount of catalogues in place should steadily increase from the start of the project onwards.

Once the guided buying solution is implemented and the milestones are reached the company can shift their focus from standardization towards integration. This might trigger integration projects and processes in other layers of the roadmap as well. The next phase of process standardization is exploring the opportunities of automation. Machine-to-machine communication is introduced as a possible future solution to relieve the workload and operational tasks from the workflow teams involved in the Purchase-to-Pay process. Once the time-consuming tasks of the workflow teams are decreased it is potentially possible to decrease the number of FTE involved in the overall process.

### 5.2.3 From a physical trigger to automatic generated purchase orders

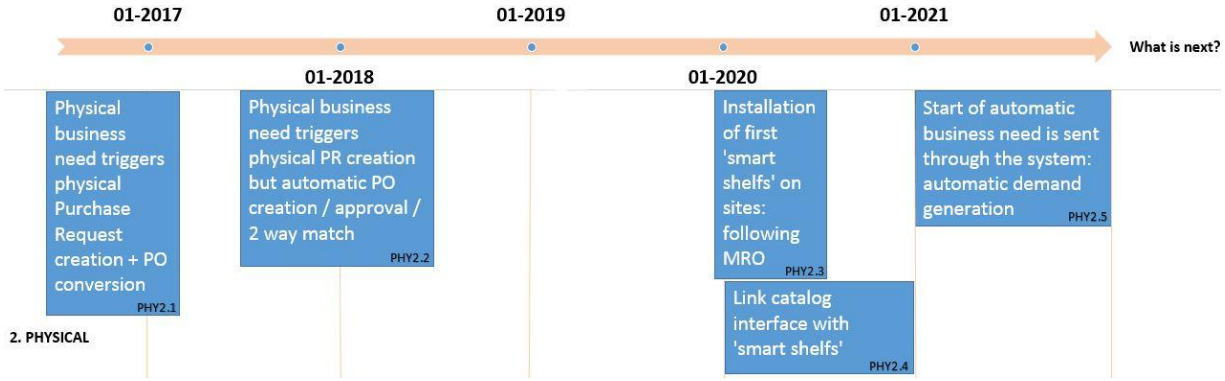



**FIGURE 19 - PHYSICAL PART OF THE PROPOSED ROADMAP**

The physical layer of the roadmap, shown in Figure 19, is focusing on the shift from a physical business need which triggers a physical purchasing order process towards a touchless ordering solution. At the moment a need is triggered by a person within an office or factory (PHY2.1). This person informs a colleague with requester rights in the system (most of the time the secretary office of a department) with their need. Next step is a physical action by the requester. The requester enters the need into the ordering system. As discussed in Chapter 4.2.4 it often happens that before creating a purchasing request in the system the requester is making use of

other, often offline, channels for sourcing and quotation of the need. The move towards a touchless ordering solution can potentially decrease the use of these offline channels and consequently decrease maverick buying.

Next phase towards a cyber-physical system is an automatic purchase order creation and approval (PHY2.2). Still the trigger is initiated by the business. Before the initial trigger can be automatically generated the processes and systems need to be able to support this. In the roadmap this is shown by a link between purchasing orders through catalogues, which provides standardization to the process, and machinery that can support machine-to-machine communication. It is proposed to install a few so called ‘smart shelfs’ on sites which might be able to link with the catalogue interface (PHY2.2 & PHY2.3). After these ‘smart shelfs’ or ‘smart vending machines’ are installed, pilots can be run. For 2021, it is proposed to have automatic demand generation embedded in the processes and systems of the company (PHY2.5).

### 5.2.4 Integration of sourcing and operational procurement is key to move into the Industry 4.0 paradigm


**FIGURE 20 - SOURCING PART OF THE PROPOSED ROADMAP**

Next layer as proposed in the roadmap is sourcing, shown in Figure 20. In this layer the focus is on closing the loop, the process of combining the strategic sourcing cycle and the procurement order cycle together.

Category strategy creation can benefit from the integration between sourcing and procurement operations as it will provide in-depth knowledge on the performance of the supplier and information on the current offer and content they provide in the Ariba environment. This integration goes through several stages and may start with transforming the legal contracts in the Ariba Source-to-Contract solution into operational contracts (SOU3.1). At time of writing, the contracts between the company and its suppliers, for Indirect Materials & Governance products and services, mainly consist of legal terms and conditions. These legal based contracts do not reflect the desired way-of-work with the supply base for the company. Therefore, it might be beneficial to extend the scope of the contract content to operational content as well. An example is to include the preferred buying channel in the contract. If the supplier is approached by the user-community through another channel than the contracted preferred one, it should not accept the request and might refer this person to the right buying channel. Including topics like this already in the contract might increase compliant behaviour by the end-user community. Broadening the scope of the contracts can provide better insights in the performance of the supplier and makes it potentially easier to integrate the loops as both parts capture the day-to-day activities with the supplier. A milestone of 100% contract compliance is set halfway 2018 as a direct result of the integration between sourcing and operational procurement.

Looking at the cyber-physical aspects of sourcing, it is shown that in 2017 there will still be physically steered negotiations (SOU3.2). Cyber negotiations are proposed to start with pilots in 2021 (SOU3.5), as there are quite a few prerequisites before machine-to-machine communication can actually take place.

Looking even further into the future might propose two groups of suppliers to engage with. One of them are suppliers within the company's network (SOU3.6a) and the other one are suppliers outside of the company's network (SOU3.6b). For the last group, suppliers outside of the company's network, a payment solution should be developed for such non-contracted suppliers before engagement can start.

### 5.2.5 Item taxonomy and reporting standardization can potentially support the move towards automated purchase order generation

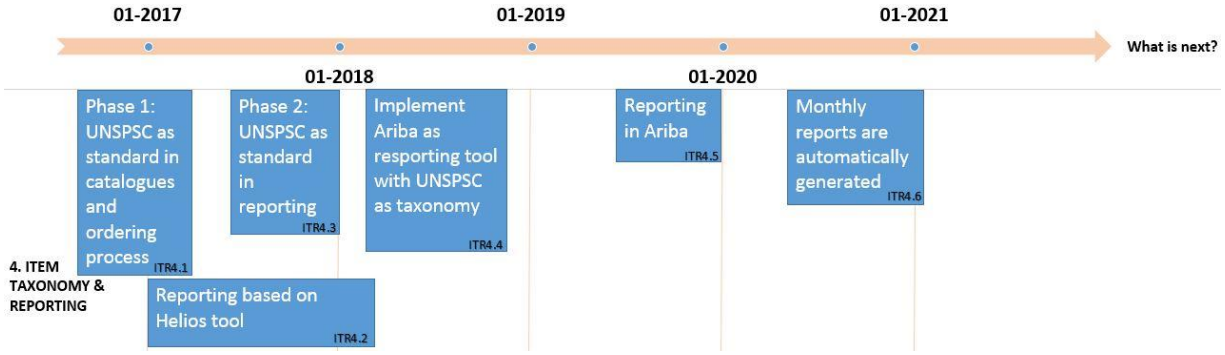



**FIGURE 21 - ITEM TAXONOMY & REPORTING PART OF THE PROPOSED ROADMAP**

An important part of both the standardization and integration phases is the product or services taxonomy. The United Nations Standard Products and Services Code (or UNSPSC) can be seen as the glue that binds together the different parts of the overall procurement process. Having the same taxonomy in place in the catalogues, the supplier contracts, the ordering process, the payment process, etc., will make integration more feasible as it makes mapping and linking the processes against each other possible.

The roadmap proposes an approach of two phases concerning item taxonomy, as shown in Figure 21. First phase is implementing the UNSPSC as taxonomy in the catalogue items and in the ordering process (ITR4.1). This will mean that the Ariba tool will run completely on UNSPSC instead of the firm specific and internally used CLOGS (Classification of Goods and Services). The second phase of the taxonomy change proposed will involve the UNSPSC implementation in the internal reporting tool, Helios (ITR4.3).

Next to reporting the item taxonomy is also important to prepare the company for closing the loop. Once both processes run on the same taxonomy, it might be easier to integrate the two as no additional mapping is necessary. The process of closing the loop is discussed next. The reporting layer is added to the roadmap because the company is currently using an internal ordering tool, names Helios, which is located outside of the Ariba environment. As standardization and integration are both key elements in the early stages of the roadmap, in might be good to look into the way-of-work concerning reporting as well.

In general, reports are created based on master data provided in the tool Helios (ITR4.2). A download of a selected part of the master data is done and exported to Microsoft Excel. There the data is used as the basis for the creation of reports by making use of pivot tables, VLOOKUP and other typical Microsoft Excel functions. All reports are then shared with the whole Indirect Materials & Services procurement community on a weekly or monthly basis. Some reports are created in Microsoft PowerPoint and show only the highlights found in the master data. Other reports, for example the monthly Procurement Savings report, is presented as a Microsoft Excel file and includes several tabs, layers, filters and macros.

Although the reports are stored in one location on the internally used online community it is not always easy for the IM&G community to find the necessary information in a quick and efficient matter. A reason for this might be that the communication about the creation of the reports and the content of the reports is not structured.

A possible improvement might be to provide reporting early on in the process through the system, to provide the Indirect Materials & Governance procurement community as well as the internal user community with specific reporting within the Ariba environment (ITR4.5). As a final future step it is proposed to generate reports automatically (ITR4.6). The enablement of such automation process requires a couple of prerequisites. Alignment in taxonomy between sourcing and operational procurement is one of them.

### 5.2.6 From Purchase-to-Order to Purchase-to-Pay, a next step in integration

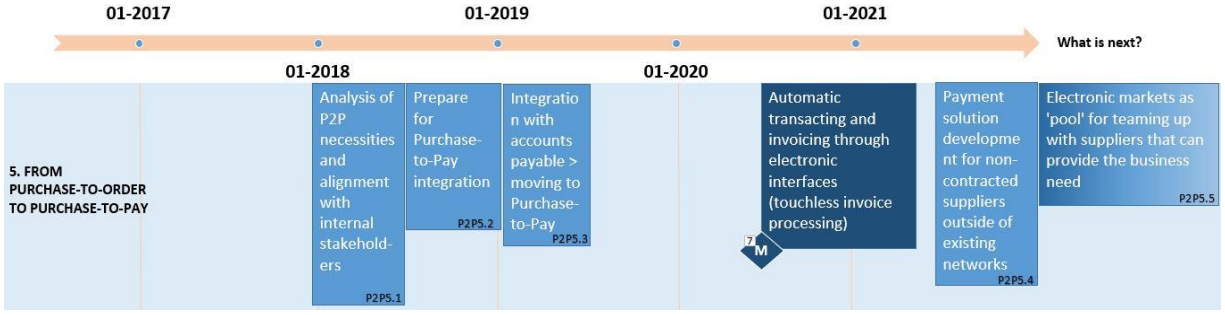



**FIGURE 22 - PURCHASE-TO-PAY PART OF THE PROPOSED ROADMAP**

The proposed roadmap is split into two phases in terms of process integration. In order to cover the process from end-to-end an integration between sourcing and the ordering process on itself is not covering everything. The move from Purchase-to-Order towards Purchase-to-Pay includes

the integration of finance and the payment process as well, this process is shown in Figure 22. If invoice management is handled in the Ariba environment it might be possible to connect that part of the end-to-end process to the reporting.

As the Accounts Payable department is a separate stakeholder in the process it is proposed to start with analysing the technical prerequisites that need to be in place in order to implement the Ariba Purchase-to-Pay solution (P2P5.1). In parallel meetings and awareness sessions on the Ariba tool might support in aligning the internal stakeholders. The integration process is not only an opportunity for the Indirect Materials & Governance procurement department but also for the Accounts Payable department. That is why both departments are equally important in making the integration work.

A way to manage this process is to approach it as a project and install a project team with representatives of both the Indirect Materials & Governance department and the Account Payable department. This project team can be given a couple of months to prepare themselves for the integration with a clearly defined design, build and test phase before the final integration between account payable and the ordering process takes place (P2P5.2).

After this preparation phase the integration project might start (P2P5.3). The final integration between the ordering process and Account Payable might affect the reporting process as well.

As a milestone for this layer of the roadmap the 1st of January 2020 is chosen. By then it is expected that an automatic transacting and invoicing structure will be in place. Automatic transacting and invoicing through electronic interfaces will potentially decrease the workload at the operational back offices of both the Indirect Materials & Services procurement and Accounts Payable. This decrease in workload can be followed by a decrease in FTE. However, it should be taken into account that there are several factors involved in the process of decreasing the number of FTEs within a company or department. As this process is too detailed and is suggested in the second and third phase of the roadmap the details of this process are out of scope in this research.

### 5.2.7 A focus on relationships and supplier management might gather strength

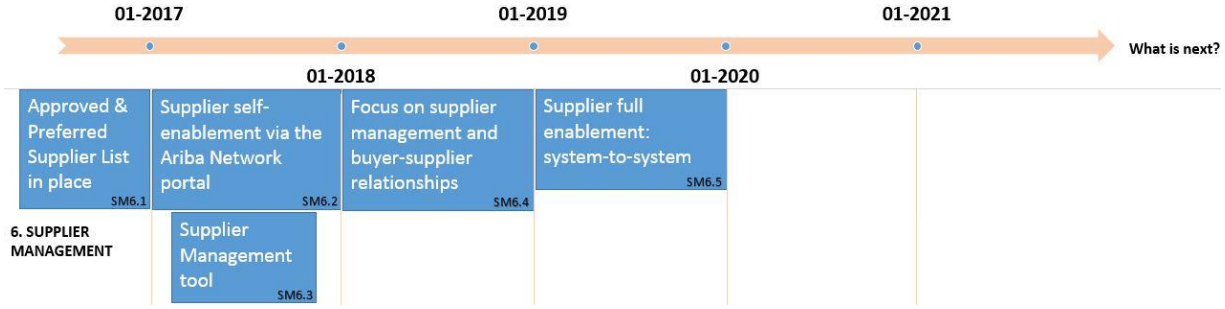



**FIGURE 23 - SUPPLIER MANAGEMENT PART OF THE PROPOSED ROADMAP**

The sixth layer of the proposed roadmap is supplier management, which is shown in Figure 23. Spend control is a high priority for the management team of the Indirect Materials & Governance procurement department. Therefore, a focus on supplier management is incorporated in the roadmap. Increased visibility into the performance of the suppliers and the compliance with the contracts in place can help to get a better picture of the performance and to increase control. The company is lacking a clear overview of the total supply base. Additionally a globally used supplier classification is missing. A few projects are running in the second half of 2016 to create a supplier list which can be filtered on commodity level and company code level. This file is enriched with supplier classification information during the time of writing this research. Suppliers can be classified as preferred, approved, flagged for deletion and banned. Any supplier which is not visible on the list, which internally is called the Approved Supplier, is a non-preferred supplier (SM6.1).

Next steps proposed in the roadmap focus on supplier enablement on the Ariba Network. Supplier self-enablement via the Ariba Network portal (SM6.2) is the first step towards automatic demand generation with a supplier. When a supplier is enabled on the Ariba Network the company can link the catalogue interface of the supplier with its own platform on the network. Next step is full enablement (SM6.5). When a requester selects a product from a supplier's catalogue on the Philips Lighting portal the request will be sent to the supplier from the network. Furthermore, the implementation of a supplier management tool (SM6.3) can help shift the focus towards supplier management and buyer-supplier relationships (SM6.4).

### 5.2.8 Indirect Materials & Governance procurement strategy; an overarching view on what are important steps into the future

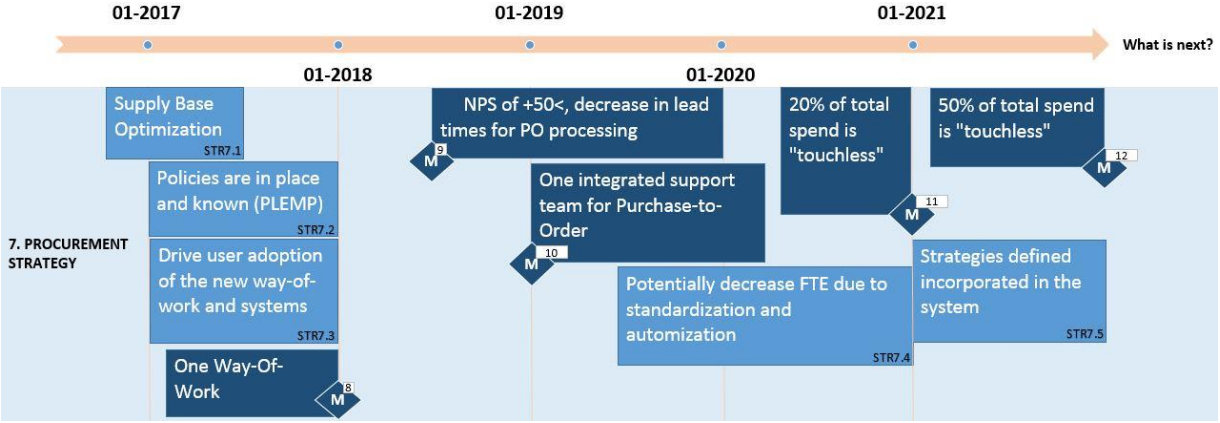



**FIGURE 24 - PROCUREMENT STRATEGY PART OF THE PROPOSED ROADMAP**

The seventh layer of the proposed roadmap is the procurement strategy, as shown in Figure 24. As discussed before, the strategy is the high level plan that works as the integrator to create a cohesive whole out of an organization's major goals and actions set.[143] The strategy outlined in the roadmap is focused on the Indirect Materials & Governance procurement department. The strategy fits the overall procurement strategy within the company which on its turn supports the general company strategy.

An important part of the strategy concerns supply base optimization (STR7.1). One of the reasons to implement a new e-procurement solution is the scattered supply base and the lack of control that relates to this. The before mentioned ASL is expected to decrease the supply base across the commodities.

Another focus point within the department its strategy is change management. Changing the daily activities and way-of-work of a user community of over 4.000 users requires a detailed change management plan. Therefore, it is suggested to provide additional guidance and support to both internal and external stakeholders, especially in the first few months after the technical go-live of the new e-procurement solution (STR7.3). Without the support of the user community a successful implementation is difficult. A reason can be that users, that might bypass the system if dissatisfied, can potentially increase instead of decrease the maverick buying.

[143] See Quinn (1980), p. 14

### 5.2.9 Having a clear view on the buying channels supports a focus on supplier management and strategic procurement

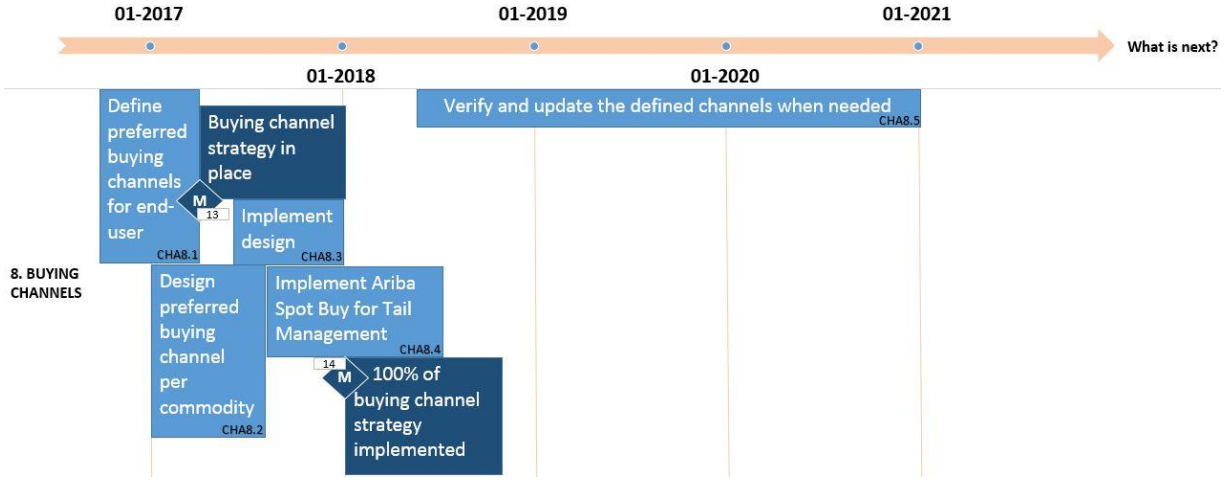



**FIGURE 25 - BUYING CHANNELS PART OF THE PROPOSED ROADMAP**

The eight layer of the proposed roadmap is buying channels, as shown in Figure 25. There are several steps in the process of buying channel implementation. The first step is to define the preferred buying channels (CHA8.1). The define phase is discussed in Chapter 4.1.2. A decision tree was created to support the commodity managers in their exercise of identifying the preferred buying channels for their commodities. The creation of a consolidated document with all preferred channels identified is planned to be delivered in the first quarter of 2017. After the 'define' phase the design phase can start (CHA8.2). Designing the preferred buying channels and catalogues is a process that requires close collaboration between the commodity managers, the catalogue project team and, if applicable, the suppliers involved.

After the design phase implementation can start (CHA8.3). Next to the implementation of the buying channel design, it is proposed to implement the Ariba Spot Buy solution (CHA8.4). This solution is created for tail management and non-repeatable spend. Although there is no specific focus on buying channels planned for 2019 onwards, the topic should not be forgotten. Verification and updating the buying channels should be part of the monthly or yearly review of the cluster in general and the commodity or sub commodity in specific

## 5.3 Wrap-up: short-term and long-term recommended implementation steps

As mentioned before, standardization and integration are proposed focus points for the upcoming two years. It is suggested to focus first on process standardization and the creation of one way-of-work throughout the process chain. Aligning the used taxonomies, in both units of measure (UOM) and United Nations Standard Products & Services Code, can help achieving this need for standardization. After taxonomy alignment the integration between sourcing, operational procurement and accounts payable can start. Process and system integration from end-to-end is an important prerequisite for machine-to-machine communication. A clear change management plan can also be seen as a short-term prerequisite. Changing the way-of-work of over 4.000 people requires buy-in of all stakeholders involved. Clear communication on the changes ahead might reassure stakeholders, and prevent them from taking a resisting stance.

A long-term vision follows the current trends in e-procurement. In 2010, Ariba focused on the look and feel of the procurement department in the future and published a vision 2020 document, in which ideas and future challenges for procurement in 2020 are highlighted by industry-leading procurement executives.

Bold statement made is that "the procurement function – as you know it – will no longer exist in 2020."[144] This statement fits the move to digitalisation and automation. Once processes and systems are integrated steps can be taken towards machine-to-machine communication. Automatic demand generation by means of linking catalogue interfaces with 'smart shelfs' automate the ordering process. Cyber negotiation can potentially automate the sourcing process. Both automatic demand generation and cyber negotiation need extensive research and data analysis to create a framework and planning to fit these concepts into the future way-of-work at Philips Lighting.

[144] SAP Ariba (2010), p. 5.

# 6 Conclusion

The research question of this research is: *To what extent does a new e-procurement solution ensure that the preferred buying channels are followed and the preferred suppliers are being used by internal stakeholders?*

Identifying a potential gap between the current state in 2016 and the possible future state was the first step in answering this research question. A gap between the current state and desired state was found. Maverick buying, no clear rules and guidelines on how to buy, and at which suppliers, a lack of spend control, and a largely scattered supply base were clear indications that the Purchase-to-Pay process at the Indirect Materials & Governance procurement department of Philips Lighting is not performing as desired.

The e-procurement solution of SAP Ariba will be implemented in the company in the first month of 2017. This e-procurement solution serves as the foundation and starting point of this research. The cloud-based e-procurement solution, additional features and solutions offered by SAP Ariba, were mapped on a five year timeline. How these features and solutions might contribute to a performance increase of the Purchase-to-Pay process is shown by arrows which symbolizes a relationship, or prerequisite, between two topics.

Two important concepts in the problem statement of Philips Lighting are preferred suppliers and preferred buying channels. There was not a clear overview of the preferred suppliers and preferred buying channels. The undesired behaviour of the internal end-user community is consequently difficult to change, as the desired behaviour is not clearly communicated. A decision tree was created to support in the creation of an overview of preferred buying channels for the internal end-user community. The unique buying channels offered by the SAP Ariba cloud-based e-procurement solution were combined with the traditional buying channels used within the company. The follow-up steps for the creation of an overview of preferred buying channels, and the communication and change management involved with this process, is captured in the proposed detailed roadmap.

An Approved Supplier List is created to inform the user-community on the preferred suppliers. This list is owned and maintained by the Indirect Materials & Governance procurement cluster teams. Several next steps are proposed and incorporated in the detailed roadmap to ensure the

development of supplier management, and communication on supplier management, within the Indirect Materials & Governance procurement department.

At the right side of the roadmap, focused on 2021 onwards, the Industry 4.0 paradigm is stretched. As discussed in the second chapter, the third industrial revolution, during the 1970s, brought automatization and digitalization. The new revolution is said to focus on Internet of Things, machine-to-machine communication and cyber-physical systems. At the moment of writing, the Philips Lighting Indirect Materials & Governance procurement department is not yet ready to join the fourth industrial revolution. Reasons for this are that the Indirect Materials & Governance Procurement department did not went through the necessary evolution stages needed to be at the doorstep of the Industry 4.0 at the start of 2017. Improvement steps during the course of the last years did not bring the company to a current status they want to be in. However, the company can achieve the next revolution of fully-automated ordering, and potentially cyber negotiation. The proposed roadmap might be a guidance for the company to move their Purchase-to-Pay process in the desired direction.

After the design phase proposed in this research, the implementation phase can start. A key success factor for bridging the gap is the support and buy-in of senior management. For a project that changes the way-of-work for many people inside the organization there should be a delicate balance between change management and the way of informing stakeholders. To ensure a smooth roll-out of the process it might be necessary to appoint ambassadors of the new way-of-work in each site or market. These ambassadors might bridge the gap between the global top-down approach, and the local bottom-up approach.

# 7 Managerial considerations

"Organizational resistance on many fronts can derail the most promising systems, even those designed to address a specific organizational pain."[145]

The abovementioned statement shows the need for a clear and strong change management process in place. All stakeholders that are involved in the Source-to-Pay process, from sourcing to accounts payable, should feel the ownership of a project like discussed in this research. If one of the stakeholder groups does not see the urge and need for change and does not prioritize it, it will be a challenging process to succeed.

There are a few commodities or sub commodities that might be interesting to run a pilot with in terms of cyber-physical systems, for example first aid kits. Items that are brought together in a first aid kit can potentially be put into a 'smart' shelf or vending machine. Maintenance and replenishment can be done automatically without involvement of the business.

Another candidate to run a pilot with are services that belong to the Freight and Distribution cluster: road distribution can be ordered and steered automatically based on data analysis of e.g. the sales orders, the sales trend, the stock levels of factories and stores and many more parameters.

These commodities or sub commodities can potentially become ambassadors of the Industry 4.0 paradigm for indirect materials and services.

In general, services do not fit on a smart shelf or smart vending machine the way physical products do. Therefore, translating services into automated demand and ordering might ask for a bit more creativity and outside-the-box thinking than traditional physical products.

The company can choose to put the highest priority in taking ownership of its current processes and systems to ensure that maverick buying will be banned, pooling of demand will strengthen its position in the buyer-supplier relationship, it is in full control of its way of work and an increase in efficiency can take place. The proposed roadmap is not the only way forward, but can help the company in designing their end-to-end multiple-year framework to increase the maturity of its Indirect Materials & Governance procurement.

[145] Watson & Haley (1998), p. 32.

The last two steps of the problem solving cycle, which are intervention, and learning and evaluation, are not incorporated in the design of this Master research. However, moving forward a clear strategy should be the foundation of these steps. Especially when there will be resistance to the implementation of the new system, or resistance during the roll-out of the system in cites world-wide, "the analysis of the resistance to this particular change is the basis for the design of the intervention strategy". [146] Such an intervention strategy might be built on three intertwined aspect systems, which are the technical system, the political system and the cultural system. These systems combine the interests of group of stakeholders, the domain of corporate and departmental culture, and the technical context of the new business system.[147]

[146] Van Aken et al. (2012), p. 142.
[147] See Van Aken et al. (2012), p. 142.

# 8 Suggestions for further research

The roadmap proposed in this paper is only one of many ways to approach the performance issues of the Purchase-to-Pay process within the firm. This roadmap might provide a solution to ensure the usage of preferred buying channels and preferred suppliers. However, this roadmap and the actions derived from it are customized for the company subject of this field problem solving project. Generalization of the conclusions should be approached with caution. Whenever it is decided to create a long-term roadmap for a company to move into the world of digitalization, automation and machine-to-machine communication it is key to start with a detailed outline of the current state. It might be the case that another company is one step behind or one step ahead of the company in this research.

As a next step the author proposes to analyse the potential impact the move towards automation and digitalization might bring. The newly invented role of the procurement department, which brings a focus on collaboration and buyer-supplier relationships, can only work if the organization is ready to take on the new role and responsibilities. The firm needs to prepare itself and be ready to focus on collaboration through cloud communities, share ideas throughout the supply chain and enable their n-tier suppliers to innovate and excel together. A possible way of fully understanding the readiness of the firm is by means of a maturity research. The maturity profile of the firm in general and the procurement department in specific can be created to analyse the readiness of the firm in adopting the future.

Other interesting topics for further research are the effect of the Industry 4.0 paradigm on the job description of the traditional purchaser, the potentially increased role of change management within procurement, the changes cyber-physical systems and machine-to-machine communication might bring to the way-of-work and the gap between literature and practice.

Last but not least it might be interesting to see the differences between a roadmap for services procurement and a roadmap for products procurement. The research scope of this research is the Indirect Materials & Governance procurement department. The direct materials, or internally called BOM procurement department, were out of scope. However, in light of the Industry 4.0 paradigm and cyber-physical systems, a closer look at the direct materials procurement processes within the company could be taken as well.

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# 10. Appendix

| **Clusters** | **Commodities** |
|---|---|
| Real Estate | Real Estate Services |
| Real Estate | Real Estate Projects |
| Real Estate | Soil Remediation |
| Real Estate | Energy |
| Real Estate | Facilities Management |
| Real Estate | Food Services |
| Business & Strategic Services | Consultancy |
| Business & Strategic Services | Law Firms |
| Business & Strategic Services | Outsourced Services |
| Business & Strategic Services | Fees & Subscriptions |
| Business & Strategic Services | Insurance |
| Marketing, Media & Events | Creative Agencies |
| Marketing, Media & Events | Marketing Services |
| Marketing, Media & Events | Sponsorships |
| Marketing, Media & Events | PR & Internal Communications |
| Marketing, Media & Events | Business & Market Intelligence |
| Marketing, Media & Events | Media |

| | |
|---|---|
| Marketing, Media & Events | Digital Marketing |
| Marketing, Media & Events | POS & Print Production |
| Marketing, Media & Events | Events |
| Marketing, Media & Events | In Store Personnel |
| Marketing, Media & Events | Customer Care |
| Marketing, Media & Events | Translations |
| Marketing, Media & Events | Design Service Delivery |
| Freight & Distribution | Sea |
| Freight & Distribution | Road |
| Freight & Distribution | Air |
| Freight & Distribution | Rail |
| Freight & Distribution | Parcel |
| Freight & Distribution | Warehousing |
| Freight & Distribution | Integrated Logistics Services |
| Freight & Distribution | Pallets |
| Freight & Distribution | FAP |
| Information Technology | Hardware |
| Information Technology | Software |
| Information Technology | Network & Telecom |

| | |
|---|---|
| Information Technology | IT Output Based Services & Time Hire |
| Information Technology | IT Data Center Services |
| Information Technology | IT End User Care |
| Human Resources & Mobility | Time Hire |
| Human Resources & Mobility | Recruitment |
| Human Resources & Mobility | Learning & Development |
| Human Resources & Mobility | Outplacement |
| Human Resources & Mobility | Health & Benefit |
| Human Resources & Mobility | Relocation |
| Human Resources & Mobility | Payroll |
| Human Resources & Mobility | Travel Agencies |
| Human Resources & Mobility | Travel - Air |
| Human Resources & Mobility | Travel - Train |
| Human Resources & Mobility | Car Rental |
| Human Resources & Mobility | Taxi Services |
| Human Resources & Mobility | Travel - Air Services |
| Human Resources & Mobility | Meetings & Events |
| Human Resources & Mobility | Hospitality |
| Human Resources & Mobility | Charge Cards |

| | |
|---|---|
| Human Resources & Mobility | Leased Cars |
| Industrial | Environmental & waste disposal |
| Industrial | Industrial Gases |
| Industrial | Industrial Services & Parts |
| Industrial | Test & Measurement |
| Industrial | Materials Handling |
| Industrial | Production Equipment |

**TABLE 4 - CLUSTERS AND THEIR RESPECTIVE COMMODITIES WITHIN THE INDIRECT MATERIALS & GOVERNANCE PROCUREMENT DEPARTMENT**