



# **Managing the Maturity Model for Qualified Information Exchange**

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# Summary

Getting trustworthy data in the right format and with the required accuracy is imperative for organizational processes. All governments face this challenge in getting the high quality data for administrative processes, decision-making and policy-making. In practice, many government agencies still struggle with getting the right data in the right format at the right moments.

Standard Business Reporting (SBR) is steadily developing towards becoming the national instrument for trustworthy data exchange. SBR includes a broad framework of standards for trustworthy data exchange and a comprehensive governance structure that steers adoption and decision making. While more public agencies are adopting SBR, this instrument itself has not developed to its full potential. Thus far, literature does not provide a model for assessing and communicating this potential.

## **Objective and Research Question**

Consequently, the main objective of this study is to develop a maturity model for assessing the potential of SBR, since a maturity model can systematically provide insight in the different aspects of the end to end data delivery chain and aid in improving these aspects to reduce administrative and regulatory burdens and increase the quality of the delivered data. However, since SBR is but a form of digital reporting, the general notion of qualified information exchange is used as a base for the development of a maturity model. Here, qualified information stands for information of acceptable quality. This raises the research question of this study: **What are the components of a maturity model for qualified information exchange?**

The notion of SBR is to reduce the administrative and regulatory burdens that are necessary in the mandatory financial reporting. This also occurs in the financial reporting in the Netherlands, where the SBR program makes use of the Dutch Taxonomy, XBRL and Digipoort as components of the end to end data delivery chain. A case study about the educational data delivery chain at the Dutch Education Services Department (DUO) is used for the development.

## **Research Approach**

This study focuses on the development of the components of the maturity model for qualified information exchange and also provides a demonstration of its usage in the case study on the educational data to DUO. To develop the components of the model, the processes of a delivery chain were examined first in order to note the different aspects of the process chain. The process is completely modeled in BPMN to the point of reception of the educational data. In the BPMN models, the involved parties are the board of directors and the supervisory board of an educational institution, the accountant who assures the data, the administration offices which sometimes take over certain tasks from the educational boards and the two online portals, the XBRL Educational Portal (XBRL onderwijsportaal) and Digipoort, which route the data to the right recipient. The

BPMN models were developed by interviewing a senior process and product expert, the advisor taxonomy and a specialist report and supervision from DUO, while also investigating internal DUO procedures.

The BPMN models were used to identify challenges in the data delivery chain. To create a more complete understanding of these challenges, two workshops and three depth interviews were held. The workshops included eighteen participants including all parties of the delivery chain, with the exception of educational board members themselves. Present were members of the educational councils to represent the educational boards, members of Logius, which governs SBR, employees from DUO and employees from the Ministry of Education, Culture and Science (OCW), who develop the law governing the mandatory reporting of data. The participants created an extensive list of challenges of the delivery chain. Some of these challenges are: the double delivery per postal service and digitally, the lack of cooperation in the development of the taxonomy and digital authentication. This study focuses on the technical challenges in the delivery chain. To validate the presented challenges by the educational council members, three additional interviews were done with educational board members. The goal of the additional interviews was to validate the challenges provided by the educational council members. In addition, the board members added a few extra challenges. The interviewees were chosen based on known availability and cooperativeness, as not all known available board members wanted to contribute to the challenges and measures.

During the two workshops and the three interviews, the participants were also asked for measures against the presented challenges. The list of measures is useful as a base for developing components for the maturity model. To create a priority scale in the maturity model, a vote was cast during the workshops and the interviewees were asked which measures they thought had the highest priority to implement. The priority scale is later used in the development of the maturity levels. The list of measures was also divided in different dimensions of a financial data delivery chain. Twenty-four dimensions were developed with the measures and by interviewing seven different experts affiliated with SBR, accounting or qualified information exchange. The experts were chosen based on availability and credibility of known knowledge. The experts also validated the dimensions and checked them on internal dependency, completeness, relevancy and consistency.

### **The Maturity Model**

The different dimensions are categorized in five different categories: (1) the exchange dimensions, which regard the exchange of data itself. It involves the medium of exchange, the medium of assurance, the intervention of human action in the exchange process and the authentication of the different parties in the exchange. (2) The data dimensions include the dimensions about the data itself: how long it takes to deliver the data, the reusability and structuredness of the data, the availability of open data and business analytics and the communication about faulty data in deliveries. (3) The data quality dimensions category manage the quality of the data, which is set to three branches: the frequency of delivery, the certainty level of the data checks and the integrity of the systems by which the data is delivered and received. (4) The standardization dimensions encompass the different forms and implications of standardization within the delivery chain. The usage of a consistent standard format, implementation of a taxonomy, standardized validations and standardized process are included in this category. (5) The final category consist of the governance dimensions, which manage the organizational side of the information exchange. The availability of knowledge of the technical aspects, the decision-making authorities, the parties that are included in the partnerships, the necessary agreements surrounding the collaborations and the base of the decision-making reasons. These five categories include all twenty-four dimensions and therefore are the components of the maturity model, encompassing the concept of qualified information exchange. These components shape the answer to the research question.

### Insights from using the model

The model is used to assess the maturity level of five SBR data delivery chains: DUO, Chamber of Commerce, SBR Wonen and, tax income delivery chains for private individuals and businesses to the Tax Agency. To demonstrate the model, the current situation of these delivery chains had to be assessed. This assessment is done via a maturity scan, which is an extensive online questionnaire with all modeled options presented over the different dimensions. The scan was emailed to several employees of each organization. These employees were known to be involved in the SBR data delivery chain of their respective organization. The maturity scan will be made public on `digicampus.tech`.

Six employees from the DUO financial justification team were found available to fill in the maturity scan and discuss the results to assess the maturity level of the delivery chain. For the other delivery chains to KVK, SBR Wonen and the Tax Agency, only one employee involved in those delivery chains was found available to fill in the maturity scan to assess the maturity level of these delivery chains. The following maturity levels were found:

<b>DUO:</b>	Level 2
<b>KVK:</b>	Level 2
<b>SBR Wonen:</b>	Level 2
<b>Tax Agency, private individuals:</b>	Level 3
<b>Tax Agency, businesses:</b>	Level 3

### A roadmap to higher maturity

A roadmap was designed for the delivery chain to DUO for future progression. Four steps were presented: (1) simple progression step, where file import is added to the online portal. (2) Digital progression, where digital assurance and digital authentication are implemented in the delivery chain, becoming a fully digitalized delivery chain. (3) System progression, where data quality is assessed based on system integrity and assured more directly. (4) Automation progression, where system-to-system is fully integrated into the delivery chain, with data level assurance and more standardized processing, reporting and benchmarking.

### Contributions and Future Research

This study contributes to research by providing a way to break the first mover problem in the business-to-government reporting chains. Furthermore, it establishes a potential goal for the government to strive towards, which also aids in the development and improvement of SBR knowledge. Thirdly, the maturity is model can be used to communicate and assess the potential of SBR, expanding the SBR knowledge. Finally, this study provides a list of perceived challenges to verify existing literature about challenges in business-to-government reporting. More practical contributions are the demonstration of the model on the DUO data delivery chain, which allows improved supervision on educational institutions and accountants if the progression steps are implemented.

This study also showed several possible future research topics. Main future research point is a study on the transition between maturity levels. The levels are proposed, but the intermediate steps to progress to the new maturity level require many organizational actions and agreements. Further research can be conducted on best practices for certain dimensions or the effect of left out technologies (e.g. biometric authentication) on the dimensions.



# Nederlandse Samenvatting

Betrouwbare gegevens in het juiste formaat en met de vereiste nauwkeurigheid krijgen, is essentieel voor organisatorische processen. Wereldwijd staan alle regeringen **FIX ME!!!!FIX ME!!!!** voor deze uitdaging bij het verkrijgen van gegevens van hoge kwaliteit voor administratieve processen, besluitvorming en beleidsvorming. In de praktijk worstelen veel overheidsinstanties nog steeds met het verkrijgen van de juiste data in het juiste formaat op de juiste momenten.

Standard Business Reporting (SBR) ontwikkelt zich gestaag tot het nationale instrument voor betrouwbare gegevensuitwisseling. SBR omvat een breed raamwerk van standaarden voor betrouwbare gegevensuitwisseling en een uitgebreide bestuursstructuur die de adoptie en besluitvorming hiervan stuurt. Terwijl steeds meer overheidsinstanties starten met SBR, is het instrument zelf nog niet ontwikkeld tot zijn volle potentie. De literatuur biedt tot dusver geen model om deze potentie te beoordelen en te communiceren.

## **Doel en Onderzoeksvraag**

Daarom is het hoofddoel van deze studie om een volwassenheidsmodel te ontwikkelen voor het beoordelen van de potentie van SBR, omdat een volwassenheidsmodel systematisch inzicht kan geven in de verschillende aspecten van de end-to-end dataleveringsketen en hulp kan bieden bij het verbeteren van deze aspecten om administratieve lasten en regeldruk te verminderen en daardoor de kwaliteit van de aangeleverde data te verhogen. Omdat SBR echter maar een vorm van digitale rapportage is, wordt de algemene notie van gekwalificeerde informatie uitwisseling als basis gebruikt voor de ontwikkeling van een volwassenheidsmodel. Dit levert de onderzoeksvraag van deze studie op: **Wat zijn de componenten van een volwassenheidsmodel voor gekwalificeerde informatie uitwisseling?**

De basis van SBR is het standaardiseren van aanleverprocessen en daardoor de administratieve lasten en regeldruk die nodig zijn in de verplichte financiële verslaggeving, te verminderen. Dit komt ook voor in de financiële verslaggeving naar de overheid in Nederland, waar het SBR-programma gebruik maakt van de Nederlandse Taxonomie, XBRL en de Digipoort als onderdelen van de end-to-end data aanleveringsketen. Voor de ontwikkeling van het volwassenheidsmodel is gebruik gemaakt van een case study over de onderwijs data aanleveringsketen bij de Dienst Uitvoering Onderwijs (DUO) in Nederland.

## **Onderzoeksaanpak**

Deze studie richt zich op de ontwikkeling van de componenten van het volwassenheidsmodel voor gekwalificeerde informatie uitwisseling en biedt ook een demonstratie aan over het gebruik ervan in de casestudy over de onderwijsgegevens naar DUO. Voor het ontwikkelen van de componenten van het model zijn eerst de processen van een aanleveringsketen onderzocht om op die manier de verschillende aspecten van de procesketen te identificeren. Het proces is volledig gemodelleerd

in BPMN tot op het punt van ontvangst van de onderwijsgegevens. In de BPMN modellen, de betrokken partijen zijn het bestuur en de raad van toezicht van een onderwijsinstelling, de accountant die de gegevens borgt, de administratiekantoren die soms bepaalde taken van de onderwijsbesturen overnemen en de twee online portalen, het XBRL onderwijsportaal en de Digipoort, die de gegevens verdelen naar de juiste ontvangers. De BPMN-modellen zijn ontwikkeld met behulp van interviews met een senior proces- en productexpert, de adviseur taxonomie en een specialist rapport en toezicht van DUO. Hiernaast is ook onderzoek gedaan naar interne DUO procedures door middel van intern beschikbare proces literatuur.

De BPMN-modellen werden gebruikt om de uitdagingen in de dataleveringsketen te identificeren. Om een volledig begrip van deze uitdagingen te ontwikkelen, waren er twee workshops en drie diepte interviews gehouden. Aan de workshops namen achttien deelnemers deel, waaronder alle partijen van de aanleverketen, met uitzondering van de onderwijsbestuurders zelf. Aanwezig waren leden van de onderwijsraden om de onderwijsbesturen te vertegenwoordigen, leden van Logius, die SBR binnen de overheid borgt, medewerkers van DUO en medewerkers van het Ministerie van Onderwijs, Cultuur en Wetenschap (OCW). Het ministerie van OCW ontwikkelt de wetgeving rondom de verplichte rapportage van onderwijsgegevens. De deelnemers creëerden een uitgebreide lijst met uitdagingen binnen de aanleveringsketen. Enkele van deze uitdagingen zijn: de dubbele levering per postdienst en digitaal, de digitale authenticatie en het gebrek aan samenwerking bij de ontwikkeling van de taxonomie. Deze studie richt zich vooral op de technische uitdagingen in de aanleveringsketen. Om de gepresenteerde uitdagingen door de onderwijsraadsleden te valideren, waren drie aanvullende interviews gedaan met bestuursleden van onderwijsinstellingen. Het doel van de aanvullende interviews was om de bedachte uitdagingen door de leden van het onderwijsraden te verifiëren. Daarnaast hebben de bestuursleden een paar extra uitdagingen toegevoegd. De geïnterviewden waren gekozen op basis van beschikbaarheid en medewerking, omdat niet alle bekende beschikbare bestuursleden wilden bijdragen aan de lijst met uitdagingen en maatregelen.

Tijdens de twee workshops en de drie interviews werden de deelnemers ook gevraagd om te brainstormen voor maatregelen tegen de gepresenteerde uitdagingen. De lijst met maatregelen is nuttig als basis voor de ontwikkeling van de componenten van het volwassenheidsmodel. Om een prioriteitsschaal tussen de componenten van het volwassenheidsmodel te creëren, werd tijdens de workshops gestemd op de maatregelen. Hiernaast werden de geïnterviewden gevraagd welke maatregelen zij de hoogste prioriteit voor implementatie gaven. De prioriteitsschaal wordt later gebruikt bij de ontwikkeling van de volwassenheidsniveaus. De maatregelen waren ook verdeeld over de verschillende aspecten van een financiële aanleveringsketen. Met de maatregelen en door middel van interviews met verschillende experts aangesloten bij SBR, boekhouding of gekwalificeerde informatie uitwisseling, zijn er vierentwintig dimensies ontwikkeld. De experts werden gekozen op basis van beschikbaarheid en bekendheid met de SBR kennis. De experts hebben daarnaast de dimensies gevalideerd op basis van interne afhankelijkheden, volledigheid, relevantie en consistentie met de andere dimensies.

### **Het Volwassenheidsmodel**

De verschillende dimensies zijn onderverdeeld in vijf verschillende categorieën: (1) de uitwisselingsdimensies, die betrekking hebben op de uitwisseling van gegevens zelf. Deze categorie omvat het medium van uitwisseling, het medium van assurance, de tussenkomst van menselijk handelen in het uitwisselingsproces en de authenticatie van de verschillende partijen in de uitwisseling. (2) De gegevensdimensies omvatten de dimensies over de data zelf: hoe lang het duurt om de data aan te leveren, de herbruikbaarheid en gestructureerdheid van de data, de beschikbaarheid van open data en business analytics en de communicatie over foutieve aanleveringen. (3) De categorie dimensies rondom gegevenskwaliteits beheert de kwaliteit van de gegevens, die is samengebracht



in drie dimensies: de frequentie van de aanlevering, het zekerheidsniveau van de datacontroles en de integriteit van de systemen waarmee de gegevens worden geleverd en ontvangen. (4) De standaardisatie dimensies omvatten de verschillende vormen en implicaties van standaardisatie binnen de aanleveringsketen. Het gebruik van een consistent standaardformaat, implementatie van een taxonomie, gestandaardiseerde validaties en gestandaardiseerde processen vallen onder deze categorie. (5) De laatste categorie omvat de governance dimensies, die de organisatorische kant van de informatie-uitwisseling beheren. De beschikbaarheid van kennis van de technische aspecten, de beslissingsbevoegdheden, de betrokken partijen in de samenwerkingsverbanden, de nodige afspraken rondom de samenwerkingen en de basis van de besluitvormingsredenen. Deze vijf categorieën omvatten alle vierentwintig dimensies en zijn daarom de componenten van het volwassenheidsmodel, dat het concept van gekwalificeerde informatie uitwisseling omvat. Deze componenten vormen het antwoord op de onderzoeksvraag.

### **Inzichten door het gebruik van het model**

Het model wordt gebruikt om het volwassenheidsniveau van vijf SBR-dataleveringsketens te beoordelen: DUO, Kamer van Koophandel (KVK), SBR Wonen en de twee aanleveringsketens van belastinginkomsten voor particulieren en bedrijven aan de Belastingdienst. Om het model te demonstreren, is de huidige situatie van deze bezorgketens beoordeeld. Deze beoordeling gebeurde via een volwassenheidsscan, een uitgebreide online vragenlijst met alle gemodelleerde opties gepresenteerd over de verschillende dimensies. De scan is per e-mail verzonden aan meerdere medewerkers van elke organisatie. Van deze medewerkers was bekend dat ze betrokken waren bij de SBR-gegevensleveringsketen van hun respectievelijke organisatie. De volwassenheidsscan wordt openbaar gemaakt op [digicampus.tech](http://digicampus.tech).

Zes medewerkers van het financiële verantwoordingsteam van DUO waren beschikbaar om de volwassenheidsscan in te vullen en de resultaten te bespreken om het volwassenheidsniveau van de aanleveringsketen te beoordelen. Voor de andere aanleveringsketens aan de KVK, SBR Wonen en de Belastingdienst heeft één medewerker per keten gereageerd en de volwassenheidsscan ingevuld om het volwassenheidsniveau van deze aanleveringsketen te beoordelen. De volgende volwassenheidsniveaus zijn gevonden:

<b>DUO:</b>	Level 2
<b>KVK:</b>	Level 2
<b>SBR Wonen:</b>	Level 2
<b>Belastingdienst, particulieren:</b>	Level 3
<b>Belastingdienst, bedrijven:</b>	Level 3

### **Een roadmap naar een hoger volwassenheidsniveau**

Een roadmap is ontworpen voor de aanleveringsketen naar DUO voor toekomstige voortgang. Vier stappen zijn gepresenteerd: (1) eenvoudige progressie, waarbij het importeren van bestanden wordt toegevoegd aan het online portaal. (2) Digitale progressie, waarbij digitale assurance en digitale authenticatie worden geïmplementeerd in de aanleveringsketen, die volledig gedigitaliseerd wordt. (3) Systemprogressie, waarbij de gegevenskwaliteit wordt beoordeeld op basis van systeemintegriteit en daardoor directer wordt verzekerd. (4) Automatiseringsprogressie, waar system-to-system volledig geïntegreerd wordt in de aanleveringsketen, met zekerheid op transactieniveau en volledig gestandaardiseerde gegevens verwerking, rapportage en benchmarking.

### **Toevoegingen en Toekomstig Onderzoek**

Dit onderzoek draagt bij aan de literatuur door een manier te bieden om het first mover-probleem in de rapportageketens te doorbreken. Bovendien stelt het een potentieel doel voor de overheid vast

om naartoe te streven, wat daarnaast helpt bij de ontwikkeling en verbetering van SBR-kennis. Ten derde kan het volwassenheidsmodel worden gebruikt om de potentie van SBR te communiceren en te beoordelen, en de kennis rondom SBR te vergroten. Ten slotte biedt deze studie een lijst met waargenomen uitdagingen in aanleverketens naar de overheid om bestaande uitdagingen in de literatuur te verifiëren. Meer praktische bijdrage is de demonstratie van het model op de gegevens aanleveringsketen van DUO, waardoor beter toezicht mogelijk is op onderwijsinstellingen en accountants als de voortgangsstappen worden doorgevoerd.

Dit onderzoek toont ook verschillende mogelijke toekomstige onderzoeksthema's. Het belangrijkste toekomstige onderzoekspunt is een onderzoek naar de overgang tussen volwassenheidsniveaus. De niveaus worden voorgesteld, maar het tussenliggende stappen om door te groeien naar het nieuwe volwassenheidsniveau vereisen veel organisatorische acties, financiële acties, overeenkomsten en communicatie. Verder onderzoek kan worden gedaan naar best practices voor bepaalde dimensies of het effect van weggelaten technologieën (bijv. biometrische authenticatie) op de dimensies.



# Contents

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<b>Summary</b> .....	<b>iii</b>
<b>Nederlandse Samenvatting</b> .....	<b>vii</b>
<b>1 Introduction</b> .....	<b>1</b>
<b>2 Research Methods</b> .....	<b>5</b>
2.1 Research Guidelines	5
2.2 Research Instruments	6
2.3 Integrating Objectives and Instruments	8
2.4 Human Research Evaluation	9
<b>3 Literature Review</b> .....	<b>11</b>
3.1 Search Description and Selection Criteria	11
3.1.1 Financial Reporting .....	11
3.1.2 Data Quality .....	12
3.1.3 Maturity Model .....	12
3.2 Findings	14
3.2.1 Business-to-Government Reporting .....	14
3.2.2 SBR Design .....	15
3.2.3 SBR Taxonomy Design .....	16
3.2.4 XBRL Design .....	17
3.2.5 Inter-Governmental Data Exchange .....	18
3.2.6 Exchange Models .....	18
3.3 Criticisms on Maturity Models	18
3.4 Concluding Remarks	19
<b>4 Data Delivery Chain Analysis</b> .....	<b>21</b>
4.1 Current Situation	21
4.1.1 Approximated Model .....	21
4.1.2 BPMN Model .....	21
4.2 Stakeholders	26
4.3 Workshops	27
4.3.1 Participants .....	27

4.3.2	Challenges .....	29
4.3.3	Measures .....	31
<b>4.4</b>	<b>Interviews</b>	<b>33</b>
<b>5</b>	<b>Maturity Model .....</b>	<b>35</b>
<b>5.1</b>	<b>Conditions</b>	<b>35</b>
<b>5.2</b>	<b>Dimensions</b>	<b>36</b>
5.2.1	Exchange Dimensions .....	36
5.2.2	Data and Data Quality Dimensions .....	36
5.2.3	Standardization Dimensions .....	39
5.2.4	Governance Dimensions .....	41
<b>5.3</b>	<b>Maturity Levels</b>	<b>45</b>
<b>5.4</b>	<b>Limitations</b>	<b>46</b>
<b>6</b>	<b>Demonstration of the Model .....</b>	<b>49</b>
<b>6.1</b>	<b>DUO</b>	<b>49</b>
6.1.1	Maturity Scan Discussion .....	49
6.1.2	Roadmap for DUO .....	51
<b>6.2</b>	<b>Other Organizations</b>	<b>54</b>
6.2.1	KVK .....	54
6.2.2	Belastingdienst .....	55
6.2.3	SBR Wonen .....	56
<b>6.3</b>	<b>Possible Dilemmas for Progression</b>	<b>57</b>
<b>6.4</b>	<b>Usage of the Scan</b>	<b>58</b>
<b>7</b>	<b>Concluding Remarks .....</b>	<b>59</b>
<b>7.1</b>	<b>Conclusion</b>	<b>59</b>
<b>7.2</b>	<b>Reflection</b>	<b>61</b>
<b>7.3</b>	<b>Limiting Factors</b>	<b>62</b>
<b>7.4</b>	<b>Future Research</b>	<b>63</b>
	<b>Bibliography .....</b>	<b>65</b>
<b>A</b>	<b>Overview of Challenges and Measures .....</b>	<b>71</b>
<b>A.1</b>	<b>Workshop Challenges</b>	<b>71</b>
<b>A.2</b>	<b>Workshop Measures</b>	<b>73</b>
<b>B</b>	<b>Checklist HREC TU Delft .....</b>	<b>79</b>



# 1. Introduction

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Worldwide, many data delivery chains are used to deliver financial data to a regulatory body or other government agency. Many countries use traditional business-to-government reporting. However, it has been criticised for being complex and inefficient [2, 3, 4] and also for imposing significant increase in administrative burdens on businesses [5]. Standard Business Reporting (SBR) is a program that proposes certain steps to reduce these burdens [6]. One of these steps in the implementation of eXtensible Business Reporting Language (XBRL), a programming language based on XML, which can facilitate structuring of information to keep them more easily accessible compared to regularly used electronic formats like PDF [4].

In the Netherlands, SBR is becoming the national standard for business reporting. Standardizing the data, processes and technology allows for unity in the administrative procedures of the government agencies. SBR uses the Dutch Taxonomy as its library, XBRL as its supporting language and Digipoort as its online routing mechanism for reports to the government. For routing to the banking environment, the BIV is used instead of Digipoort [7]. Several Dutch governmental agencies have started to use the SBR program for their financial reporting programs: the Chamber of Commerce (KVK), the Tax Agency, the housing corporations via SBR Wonen and the Educational Service Department (DUO). These delivery chains all use the Digipoort as their routing mechanism.

In this study, the focus will be on the delivery chain of educational financial data to DUO. The SBR program was started at DUO several years ago with a voluntary digital delivery chain via the Onderwijsportaal and the Digipoort to DUO. This delivery chain delivers its data in the XBRL file format. Since 2016 all educational institutions deliver their financial data digitally in XBRL next to the still mandatory postal delivery route. Educational institutions deliver their financial data annually to DUO, who checks, administrates and analyses the data to create forecasts on the contributions to institutions. The financial data includes the financial statements, the accompanying board report, the Auditor's report from an external accountant and sometimes a report of findings. Currently, this information is sent to DUO via postal service, while the digital route only delivers the financial statements, without assurance by an external accountant. The digital route does validate the financial statements via the Dutch Taxonomy in the Onderwijsportaal and the Digipoort (double validation).

The double delivery seems unnecessary, but law mandates that the data is delivered via both routes. The delivered data is then divided over the different appropriate departments, which will analyse and administrate the data. The analysis and administration steps within DUO are done manually, since data is received on paper by postal service. Therefore, automated digital processing is usually not possible. This creates an environment in which many steps are done multiple times, which take significant time and effort and also enlarge the error sensitivity. Some to all of these

steps could be automated digitally.

Educational Institutions sometimes make use of administration offices to do certain tasks for them. This can range from only composing the financial statements to developing a mission and vision for the institution and managing all financial tasks. The manual entering of the financial statements to the Onderwijsportaal is also done by the administration offices. The fact that administration offices are used, indicate a level of pain in the current delivery chain. Past interviews, as provided by the advisor taxonomy, indicated more pain points:

- The double delivery to DUO, which is done both on paper and digitally.
- The inability to direct provide feedback to the delivering agent if an error is made in manually inputting the data. At the moment, an error requires an investigation by the accountant and/or DUO where and what the error implies and how to restore it.
- The manual approval by accountants, which creates a strain on the DUO personnel to process the data as they have to wait for the approval.
- The manual entering of data to the online portal.

To structurally combat these pain points, a model can be developed to progress in a structured way. This model can render the different steps that need to be taken to progress to an improved delivery chain with less pain points, which can be seen as a more mature delivery chain. An opportunity is to generalize the data delivery chain progressions to a generic maturity model, which can be applied to more delivery chains. A generic maturity model can then describe how a delivery chain is functioning, what parts contain challenges or opportunities and prescribe what steps may be taken in order to improve the delivery chains in many areas and take these opportunities [8]. Important to note is the ability to maintain the quality of the data in the progression of the delivery chain. To develop a maturity model for qualified information exchange gives rise to the research objective:

### **What are the components of a maturity model for qualified information exchange?**

The research objective is split into several subquestions:

1. What is the current SBR data delivery chain to DUO?
2. What are the current perceived challenges/barriers in the SBR data delivery chain?
3. What are potential measures to these challenges/barriers?
4. What dimensions are needed for a maturity model?
5. Which dimensions have a higher priority?
6. How do organizations score on the maturity model?

The subquestions are necessary to answer the main research question. In order to investigate the different components for a maturity model, the delivery chain needs to be analysed. The analysis will give insight in the different important aspects of the delivery chain. Therefore the current SBR data delivery chain will be analysed (1). To develop a progressive model, the pain points or challenges need to be removed in more mature levels. To develop measures against the challenges, the perceived challenges need to be listed and analysed (2). With an analysed overview of the challenges, potential measures to the challenges can be developed (3). These measures are necessary to develop the more mature options for different aspects of the maturity model.

The base components of a maturity model are the dimensions of the model, which indicate the different aspects of a delivery chain. Each dimension has several options. Here the options have a maturity scale among them, which makes one option more mature than other options. To develop these dimensions with the options, the previously mentioned measures can be used (4).

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Since a maturity model evaluates a delivery chain on different dimensions, not all dimensions are mandated to result to the same maturity level. Differences in maturity levels among different dimensions is very likely. Therefore a priority scale is necessary among the dimensions. The high priority dimensions can then translate to the key conditions for the maturity levels (5). The final subquestion verifies the generality and usability of the model by demonstrating the maturity model and evaluating delivery chains from organizations. The generality is necessary for a generic maturity model to be usable in other situations. The usability is necessary for the evaluation of delivery chains, since these delivery chains cannot be improved in maturity level if the current maturity level cannot be established (6).

This study contributes to the wider research in several ways. Firstly, it allows for the possibility to break the dilemma about the lack of incentive for first movers to develop a standard. This lack of incentive comes from the reason that those who did not contribute to the development of the standard cannot be excluded from the benefits [9]. A maturity model for qualified information exchange could establish a potential goal for the government to strive. The government will then break the dilemma for businesses by developing the standard, allowing all business to benefit equally while also establishing a standard. Secondly, the potential establishment of a goal aids in the development and improvement of the SBR knowledge. It structurally evaluates the delivery chain on the dimensions, which act as criteria for improvement. Research on SBR can make use of such a model as a base for evaluation and potential goals of delivery chains. Since SBR focusses mainly on standardized digital submit & accept procedures, the maturity model can expand the SBR horizon by proposing possibilities beyond the SBR focus. Finally, the more mature levels of the maturity model need to combat existing or perceived challenges in a delivery chain. Therefore these challenges need to be listed. This list allows for verification of existing literature about challenges business-to-government reporting, increasing the knowledge about possible challenges in business-to-government delivery chains.

A more practical application of the maturity model is the development of improved supervision on educational institutions<sup>1</sup> and, if applicated to other delivery chains, companies that need supervision. This also applies to accountants that (mistakenly or intentionally) approve or disapprove financial statements<sup>2</sup>. It therefore can reach a much broader environment that just the educational data delivery chain to DUO and can also re-activate people and organizations in order to break a possible stalemate.

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<sup>1</sup>A recent example of an educational institution that requires supervision is the case of Grotius College in Delft. Large-scale fraud was committed by the board director, which leaves the school with a loan of €1.5 million by the municipality in order to survive [10].

<sup>2</sup>Another recent example of a financial debacle. Two former KPMG accountants approved a shady refinancing of the company BoerCroon, which later led to bankruptcy of the company [11].







## 2. Research Methods

This study focuses on the development of the components required to build a maturity model for qualified information exchange. Different kinds of approaches can be used to develop these kind of models. This study has chosen to use design research as its approach [12]. Design research is chosen since it is commonly used to develop an artifact. The maturity model is seen as the artifact in this process, hence design research can be used. The choice is reinforced by the fact that design science research *seeks to extend the boundaries of human and organizational capabilities by creating new and innovative artifacts* [12, p. 75]. First, in section 2.1 the guidelines for design research are set and explained. Secondly, in section 2.2 the instruments for researching the different types of necessary data are proposed. Thirdly, in section 2.3 the research objectives and the research instruments are combined to form an overview of the research methods and the proposed results of every research instrument. Finally, a human research evaluation is added in section 2.4, since research studies involving a human element (in this case via workshops and interviews) require a human risk assessment from an ethically point of view.

### 2.1 Research Guidelines

The research objectives were presented in the introduction via the main research question and the six subquestions. In this section, the research environment will be presented via the seven design-science research guidelines proposed by Hevner et al. (2004) [12, p. 83]. These guidelines represent the conditions for the effective and complete use of design science research and will therefore be presented. The seven guidelines are also presented in table 2.1. Following the example application of Aalst and Kumar (2003) in [12], the designed artefact will be the maturity model (Guideline 1). This is relevant since literature does not provide a model for assessing and communicating the potential of SBR for business-to-government reporting (Guideline 2). The evaluation of this potential is presented via the assessment of several SBR data delivery chains. The assessment of different SBR data delivery chains verifies the generality and potential for communication of the maturity model (Guideline 3).

This study will present a maturity model to assess and communicate the potential of SBR, while also expanding this potential via different dimensions. These dimensions will be developed through literature research, workshops and interviews, but will also verify existing perceived challenges in current SBR data delivery chains. This verification is obtained in the dimensions development process. To develop the dimensions, the current perceived challenges are listed to develop measures to these challenges and therefore higher maturity level options of dimensions (Guideline 4). The dimensions of the model will undergo severe testing via interviews and workshops to ensure all dimensions are relevant, consistent and complete and therefore create a rigor model. This rigor is necessary to keep the generality of the model intact and to keep the model applicable to multiple SBR data delivery chains (Guideline 5). Utilizing BPMN models to understand the current SBR

data delivery chain of the case study, combined with workshops and interviews about the data delivery chain, allows for a better understanding of the challenges within the data delivery chain. During these workshops and interviews, several measures were developed to combat the listed challenges. These measures, aided by a literature study, will allow the development of the dimensions, because the challenges and measures are based on certain aspects of the delivery chain. These different aspects are the foundation to the dimensions that are included in the maturity model (Guideline 6).

The research will be communicated via a thesis as well as a presentation. It will provide the obtained knowledge of the workings of the SBR process, the analysis of the data delivery processes as well as evaluations of the different dimensions and the maturity model itself. The thesis will provide a summary for management-oriented audiences in both English and Dutch. The agile Business Process Management Notation (BPMN) models will provide the details of the delivery chain, whereas the maturity scan will provide insight in the workings of other data delivery chains. The maturity scan will also be made publicly available on `digicampus.tech` for future use. A disclaimer for use will be provided (Guideline 7).

Table 2.1: Research guidelines for design-science. Adapted from [12, p. 83].

<b>Design-Science Research Guidelines</b>
Guideline 1: Design as an Artefact
Guideline 2: Problem Relevance
Guideline 3: Design Evaluation
Guideline 4: Research Contributions
Guideline 5: Research Rigor
Guideline 6: Design as a Search Process
Guideline 7: Communication of Research

## 2.2 Research Instruments

The guidelines serve to create the artefact, however to create that artefact more information is necessary. Based on the different subquestions, multiple types of data are needed. The different types of data are listed:

1. The full educational data delivery chain to DUO, to develop the BPMN models so the challenges and measures can be identified.
2. The challenges/barriers in the system in order to verify them and to develop measures to these challenges.
3. Useful measures to these challenges/barriers, which identify certain aspects of the data delivery chain, which are the base in developing the dimensions.
4. Dimensions surrounding the delivery chain, which are the main components of the maturity model and include all aspects of the data delivery chain.
5. Verification of the dimensions, to ensure the completeness, relevancy and consistency of and among all dimensions.
6. Priorities regarding the solutions to challenges/barriers, to develop the key criteria of the maturity model, which regard differences among the maturity levels.
7. The maturity level of organizations, to verify the generality and applicability of the maturity model on other SBR data delivery chains.

To obtain these data types, different research methods are available. Whereas some require assistance from stakeholders from the delivery chain, others require a literature review. Descending

from top to bottom: The full delivery chain will be researched by doing literature research on the DUO internal network and small interviews with different process employees within DUO. A Senior Process and Product Expert, the Advisor Taxonomy and a Specialist Report and Supervision will be interviewed to ensure the accurateness of the defined process. The process will be mapped in the Business Process Model Notation and created in the free online program Draw.io [13]. The full SBR data delivery chain is necessary to be mapped in order to identify the challenges of the current data delivery chain (1).

The challenges/barriers (from now on called: challenges) are implicit in the delivery chain and differ per interpretation of a stakeholder. As stakeholders might look differently onto different parts of the chain, different outcomes may appear. By analyzing the process model different deficiencies can be identified which can be regarded as challenges or general inefficiencies. This lays the focus on technical challenges, therefore less focus on stakeholder power and power struggles is made. However, even though the focus is not on the stakeholders, to obtain indepth data about the perceived more technical inefficiencies, the stakeholders must be interviewed. This will be done via workshops with the policy makers from the Ministry of Education, Culture and Science (OCW), employees of DUO, employees of Logius and members of the councils of the different educational layers in the Netherlands. As these different educational layers may perceive certain process steps differently, it is valuable to invite multiple councils to the workshops to obtain as much information as possible. The participants will be selected based on availability, cooperativeness and involvement about the SBR data delivery chain. To ensure fairness and equal representation during the workshops, an equal number of participants from all parties will be invited. Due to the worldwide COVID situation, the workshop shall be held online, which restricts the amount of participants to keep the discussions during the workshops viable. Therefore, about five members of each organization are invited based on previously mentioned criteria. To verify the data generated by the workshop, indepth interviews will be held. Three additional interviews will be held with educational board members instead of council members to ensure the data generated by the council members in the workshop is accurate. When the generated data by the council members corresponds with de data from the interviews with the board members, the data is validated to a certain degree (2).

With the results of the workshops available, several types of measures were proposed by the participants of the workshops and depth interviews. These measures indicate different aspects and improvements of the data delivery chain, which can be generalized as the exchange of qualified information, with qualified information defined as the information of acceptable quality (3 and 4). The set of dimensions is completed by literature and will be expanded, improved and validated by interviews with experts in the SBR field. Seven interviews have been held in order to validate the set of dimensions on completeness, relevancy and internal consistency among all dimensions. These interviewees have been selected based on knowledge about SBR and availability, mostly via the SBR Renewal Program (SBR Vernieuwing) (5). By combining the verified options and the prioritized measures from the workshop, the aspects of the key criteria of the maturity levels are identified. These aspects are then transformed to the key criteria themselves by inserting them into the dimensions (6).

A maturity scan will be developed in order to accomodate organizations in assessing the maturity level of their organization. The scan evaluates all dimensions and its options and calculates a score based on those answers. This score gives an indication of the maturity level of the data delivery chain. The score will then be translated into a maturity level based on the previously mentioned key criteria. The ability to score the different types of SBR data delivery chains on a single scale validates the generality of the maturity model (7).

### 2.3 Integrating Objectives and Instruments

Combining the research objectives and the research instruments gives an overview of the research methods for this study. This overview is given in table 2.2 with the research objectives from section 2.1 and combines them with the chosen research instruments in the second column and the intended results in the third column, both from section 2.2.

By interviewing process experts at DUO and using internal process documents, the current situation can be visualized in the form of a BPMN model. The BPMN model will give insight in the current SBR data delivery chain processes at DUO. It will also assist in the workshop and depth interviews as explanation of the current situation and possibly visualizing the current challenges in the delivery chain. The workshop and interviews will generate the necessary data to create a set of dimensions for the maturity model. However, to create a realistic maturity model, the dimensions must be evaluated in terms of completeness, consistency and relevancy. The evaluation is done by interviewing experts on the fields of SBR and/or accounting, combined with literature on the dimensions. The evaluation, together with the obtained priorities by the stakeholders from the workshop and interviews, will result in a complete maturity model with key conditions for the maturity levels [14]. The maturity model implicitly contains a roadmap for organizations as DUO to improve their information exchange. The maturity scan will be used to describe the maturity level of organizations. The key conditions will then provide the further steps in order to reach a higher maturity level. The scan also allows for the verification of the generality of the maturity model by its ability to assess different types of SBR data delivery chains. A final result is that the maturity model may aid in breaking stalemates in organizations and assist in the improvement of delivery chains.

Table 2.2: Integrating research questions and research instruments

Research Objective	Research Instrument	Result
(1) What is the current data delivery chain from educational institutions to DUO?	Literature and interviews with DUO employees	BPMN design: data delivery process in the current situation
(2) What are challenges in the current data delivery chain? + (3) What are potential measures to these challenges?	Workshops with policy makers and educational council members + deepening interviews with educational board members	List of challenges, list of measures to solve these challenges, priority list of these measures
(4) What dimensions are needed for the maturity model?	Literature and interviews with SBR experts	List of dimensions for the maturity model, including options for every dimension
(5) Which dimensions are more important?	Analysis of the results of the workshops and interviews	Key conditions for the maturity levels of the maturity model
(6) How do organizations score on the maturity model?	Results of the maturity scan filled in by different organizations	Overview of the maturity of different organizations and an implicit roadmap for these organizations

## 2.4 Human Research Evaluation

The research approach includes workshops, interviews and a questionnaire, which are considered human research [15]. Therefore a risk assessment is necessary for the human components of the research. The human research ethics committee mandates this risk assessment if any sort of human research is used in the research. However, if the risk was shown to be minimal, the form did not have to be delivered to the committee. To be on the safe side, potential risk situations were still assessed in order to start the research. Therefore the checklist will be completed as well as the safeguards for anonymity (or consent) and storage of data are discussed. For completion, the filled in form is included in the appendix in appendix B, but can online be found on: <https://www.tudelft.nl/over-tu-delft/strategie/integriteitsbeleid/human-research-ethics/application/>. The complete form also includes checks irrelevant for this research, such as the usage of drugs or receiving of pain.

All interviews, workshops and the questionnaire were held voluntarily by the participants. The invitation stated that the participating was voluntarily, which consent was given if the person participated. Due to the coronavirus, all workshops and interviews were done remotely or via any form of video conference call. This allowed the participants to choose to be visible to the researchers and other participants or not. It was not mandatory to turn on the camera. The remotely done workshops and interviews also safeguarded the stored data, as it was stored locally on a personally accessible only computer. Therefore other participants or malicious parties could not access the firewall protected data. However, a short summary of the results was provided to only the participants shortly after the conclusion of the workshops or interviews.

The results of the questionnaire, the maturity scan, were stored locally as well, inaccessible to other participants or malicious parties. The questionnaire also informed parties of consenting to use their email in order to ask deepening questions about the given answers. Participants voluntarily accepted the consent when the questionnaire was filled in and sent.





## 3. Literature Review

*Titlepage ©Taxonomy Australia [16]*

To start researching the topic, a review on the current literature has to be done. The found literature will focus the scope of the research as well as provide insight in what has been researched before and what has yet to be done.

### 3.1 Search Description and Selection Criteria

The literature review is done mainly via Scopus, but also partly via Google Scholar. Searching for articles on Scopus and Google Scholar was done by using Boolean Operators, which amplify the usage of the online academic search engines [17]. The search was done in three parts: part one focused on the financial reporting side of the research objectives, including the taxonomy and XBRL. Part two focused on the data quality improvements and public agencies. Part 3 focuses on the maturity models itself. The separation is done due to the different angles of the study. Starting with the financial reporting part to tackle the current financial data delivery chain, followed by the data quality part to tackle the dimensions of the maturity model as well as the challenges and measures of the financial data delivery chain, and ending with the maturity model part to tackle the maturity model itself. All search parts are listed in table 3.1 and the search descriptions are elaborated on in sections 3.1.1, 3.1.2 and 3.1.3 respectively. The findings of the searches are combined and presented in section 3.2.

Apart from the three parts of research, a separate section was added on criticisms on maturity models. This section was included separately due to its importance in evaluating maturity models and their pitfalls. The found pitfalls and shortcomings on maturity models that were found in literature are presented in section 3.3.

#### 3.1.1 Financial Reporting

Using starting parameters "XBRL" and "Financial Reporting" many results for part one were found. These results were refined by adding or removing several parameters including their synonyms. Firstly, the parameter taxonomy was added including its synonyms by adding the ~-sign in front of it. This removed a large quantity of search results and decreased the amount to 549 results. As taxonomy is part of the main subject of this literature review, it was decided that it had to be included in the search parameters of keywords of an article to be qualified as valid.

Because the taxonomy is researched for the Educational Performance Service DUO, it was added to the search query. However, as expected beforehand, the term "DUO" was interpreted as duo double, therefore resulting in wrong duo statements. No articles about the Educational Performance Service DUO were found in the list of only 12 results. Next, the parameter SBR from Standard Business Reporting was added to the query. This resulted in an acceptable amount of 183 results. Adding the

parameter "advantages" with the synonym marker attached, decreased the amount of results to 161.

However, after closer inspection, many hits were from before the complete operation of the Standard Business Reporting in the Netherlands in 2015, therefore eliminating most of these results. This was simplified by selecting the Google Scholar option of "Since 2016" eliminating all results from 2015 and before. Running the same search query of "XBRL AND *financial reporting*" AND *~taxonomy AND SBR AND ~advantages*" but with results since 2016, the amount decreased significantly to 38 results. Unfortunately, the abbreviation of Standard Business Reporting was used, but some papers only use the full title, therefore the query was extended by replacing *SBR* with *SBR OR "Standard Business Reporting"*. This resulted in 15 more results, which have to be considered beforehand by reading the abstracts as they can add valuable information. This search process is listed in table 3.1, part 1, in order of mention.

### 3.1.2 Data Quality

The second part is started using the parameters "data quality" and "system quality" for 17900 results. Adding the "SBR" parameter, decreased the amount of results in general, but increased the amount of results of other domains. Many computational science reports were found and many reports regarding the full expressing of SBR were lost, resulting in 1700 results. Therefore the addition of "Standard Business Reporting" was added to the SBR parameter, the same as in part one. This slightly increased the amount of results to 1740, questioning the relevancy of the addition. The domain, however, was still too broad containing many physics, chemistry and computational science results.

Adding the term *~advantages* to the query, resulting in *"data quality" OR "system quality" AND SBR OR "Standard Business Reporting" AND ~improvement* reduced the amount of results to 1280, which is regarded as too many results. Therefore the terms "XBRL" and "public agencies" were added, reducing the amount of results to 97 and 9, respectively. These 9 reports were considered beforehand by reading the abstracts as they can add valuable information. This part of the search process is listed in table 3.1, part 2.

The titles of the final result query of both parts were evaluated based on their domains, titles and abstracts. Therefore a lot of results were discarded as their domain was pure financial market, stock market, exchange market or implementation of XBRL in financial markets of foreign countries. As XBRL is already (partially) implemented in the Netherlands, the initial implementation is outside of the scope of this review. This results eventually in 15 articles to be considered for this review.

### 3.1.3 Maturity Model

The final part is started with the search parameter "Maturity Model" with 87800 results. Therefore the search was refined to delivery chains by adding this to the search query. The results decreased to 121 results, however, many articles were about supply chain management, as delivery chains also play an important role in that business. Therefore 'financial' was added as a parameter. This generated results surrounding the banking sector, which suppressed other results. Removing 'financial' as a parameter but adding 'Qualified information exchange' resulted into more relevant results regarding information exchange models and qualified information articles. Adding the 'government' parameter to the search query finalizes the search resulting in the relevant articles regarding qualified information models and governmental processes. The articles were finally selected after scanning the domains, titles and reading their abstracts.



Table 3.1: Search parameters in Google Scholar using the notation according to [17].

Terms	Hits	Remarks
<b>Part 1</b>		
XBRL AND "financial reporting"	1700	
XBRL AND "financial reporting" AND ~taxonomy	549	
XBRL AND "financial reporting" AND ~taxonomy AND DUO	12	Wrong DUO
XBRL AND "financial reporting" AND ~taxonomy AND SBR	183	
XBRL AND "financial reporting" AND ~taxonomy AND SBR AND ~advantages	161	Many old hits
XBRL AND "financial reporting" AND ~taxonomy AND SBR AND duo	1	Wrong DUO
XBRL AND "financial reporting" AND ~taxonomy AND SBR AND ~advantages	38	Since 2016
XBRL AND "financial reporting" AND ~taxonomy AND SBR OR "Standard Business Reporting" AND ~advantages	53	
<b>Part 2</b>		
"data quality" OR "system quality"	17900	
"data quality" AND "system quality"	6160	Removes articles
"data quality" OR "system quality" AND SBR	1700	Missing items
"data quality" OR "system quality" AND SBR OR "Standard Business Reporting"	1740	Domain too broad
"data quality" OR "system quality" AND SBR OR "Standard Business Reporting" AND ~improvement	1280	Too many hits
"data quality" OR "system quality" AND SBR OR "Standard Business Reporting" AND ~improvement AND XBRL	97	
"data quality" OR "system quality" AND SBR OR "Standard Business Reporting" AND ~improvement AND XBRL AND "public agencies"	9	
<b>Part 3</b>		
"Maturity Model"	87800	
"Maturity Model" AND "delivery chain"	121	many supply chain options
"Maturity Model" AND "delivery chain" AND financial	99	Banking sector results
"Maturity Model" AND "delivery chain" AND Qualified information exchange	52	
"Maturity Model" AND "delivery chain" AND Qualified information exchange AND government	48	

## 3.2 Findings

The articles that were chosen are divided in several subcategories. These categories group the articles under a common banner. It is possible that articles are partly grouped in several subcategories. Following the process of SBR and XBRL, the subcategories are logically ordered. Starting with the Business-to-Government reporting in section 3.2.1, the articles about reporting are explained, these articles write about the domains of reporting to governmental instances and the differences in governmental reporting between countries.

Following the governmental reporting section is the section about the design of the Standard Business Reporting or SBR. As SBR is design in the past, some relatively old articles will be used to explain the emergence of SBR and its usages. The explanation around SBR design is done in section 3.2.2. Next the articles about the taxonomy behind the SBR will be shown. These articles indicate the designs surrounding the taxonomy and its usage in SBR. The taxonomy is used via the eXtensible Business Reporting Language or XBRL, which is a computer language dedicated to business reporting. This will be shown in section 3.2.3.

The XBRL design itself will be shortly addressed on itself in section 3.2.4, This section will explain the design behind XBRL and its usage in the taxonomy. Finally, the data exchange between public agencies will be discussed in section 3.2.5, which could require XBRL.

### 3.2.1 Business-to-Government Reporting

Each country around the world has their government divided into subparts or departments. These departments are usually different per country. For example, in the Netherlands, the ministry of Education, Culture and Science oversees these parts, but in other countries, the education department, culture department and science department may be allocated under different ministries. This creates an unequal amount of different governmental departments who all need data from companies in their country. For the companies, this creates additional burden to provide this information to the different departments [6]. Therefore, a single system is developed to provide the business-to-government information. This system is Standard Business Reporting and mostly uses XBRL to allow companies to provide it with increased ease.

The benefits, however, do not come at once. Several hurdles need to be overcome before all the decreased costs and time will be enabled. The transition from the manual business reporting to the digital reporting was done differently in different countries. Troshani et al. (2018) [4] compared three different countries and their transition from the manual reporting to the digital SBR reporting. These countries were Australia, the United Kingdom and the Netherlands. The transition was also mentioned by Bharosa et al. (2011) [6]. They derived a set of principles which guide the transition from a single case study: The Netherlands. Whereas Troshani et al. (2018) [4] reported the authorities and transitions among the three countries, Bharosa et al. (2011) [6] reported the underlying principles for these transitions.

Bharosa et al. (2018) [18] expand on this phenomenon by focusing on the steering instruments that are usable by the governmental departments to ensure the reporting is done correctly according to the government itself. These steering instruments are also reported in the Dutch case of Troshani et al. (2018) [4] when comparing the three countries and their ideas in reporting the business data. The article by Praditya et al. (2016) [19] explored the actual framework of XBRL as a use for business-to-government reporting. The different determinants cause different adoption rates and implementation rates, which were also named in the article by Troshani et al. (2018) [4] as benchmarks for the implementation.

However, where Troshani et al. (2018) [4] calls the implementations, Praditya et al. (2016) [19] mandates the actual differences after the voluntary to mandatory change. The change from voluntary to mandatory digital was mentioned by Troshani et al. (2018) [4], but without much depth and was shown more as the difference between the United Kingdom, where the digital reporting is mandatory, and Australia and the Netherlands, where the reporting can be chosen by the companies and therefore the digital reporting is voluntary.

The article by Bharosa et al. (2013) [20] expands the business-to-government reporting structure by pressing data quality. To increase this data quality, the data control has to happen upstream, in order to reduce the risk of expanding any errors. To accomplish this upstream control, *a well-aligned combination of data standardization (using shared syntax and semantics) and automated information processing (using an intelligent gateway between businesses and government agencies)* is needed [20, p. 1]. This could be made possible by using XBRL as shown in section 3.2.4.

The different articles are complementing each other. Each article focuses on a different detail without straying away from the main core elements of the article. However, to implement a standard reporting system, the system itself needs to be developed.

### 3.2.2 SBR Design

The major problem with SBR is that it is a so-called 'contradictio in terminis': there is no standard Standard Business Reporting system, therefore contradicting itself [21]. As the article by Sinnott and Willis (2009) [22, p. 24] states: "*SBR is not universally understood*". It has underlying common elements, but there is no single result from the combination of these elements. However, as it is also stated, this seems to be no problem for national business reporting, as the SBR is usually nationally defined. For international business reports, there have to be specialized commodities to accommodate both the country of the company and the country of the government.

The differences of the SBR are mainly sought at the governmental side of the system. As stated before, government structures and therefore departments differ per country. For the system in Australia as researched in the article by Troshani et al. (2018) [4], Australia has several layers of government, which all request different business information. The federal government requests different information from companies than the territorial/state governments. In comparison, the Dutch government has only one governmental layer that requests the business reports from which the different departments all take their needed information.

The principles which are derived from the launch of the SBR in the Netherlands were summarized in the article by Bharosa et al. (2011) [23]. This article was extended in the article by Bharosa et al. (2011) [6]. This article also expands on the future research possibilities as well as future possibilities of the SBR itself. The seven principles gained from the case study of the Netherlands are (as explained in the article by Bharosa et al. (2011) [6, p. 154-156]):

1. Make SBR a by-product of the data already in the company's accounting systems
2. Include controls for auditing in software
3. Keep the business focus
4. Position SBR as a cross-government policy initiative
5. Stimulate private sector involvement
6. Combine restrictive and flexible project management strategies
7. Underline the attention given to end-to-end security over the reporting chain

As seen in the listed principles, the authors state the SBR principle "Keep the business focus". This, however, may raise some unforeseen problems with the different kinds of businesses within a single country, therefore creating multiple SBR designs and partly undermining the thought of a single standardized Standard Business Reporting. In contrast, most countries such as the Netherlands operate with a single government that requires the full information. Even in countries that operate on multiple levels of governments, such as the aforementioned example of Australia (Federal versus territorial/state), it is safe to say that the amount of businesses exceeds the amount of government levels. Therefore if the SBR design is government focused, with extensions/elements to be modified to each company's wishes, the SBR keeps its singular standardized design.

The articles in this section overlap and complement each other, whereas they also have a connection with the business-to-government reporting articles from section 3.2.1. The reports that provide the business data to the governments can be set up in different hierarchies. This is where the taxonomy of the data is important.

### 3.2.3 SBR Taxonomy Design

The taxonomy development based on the principle of 'Stimulate private sector involvement' from the prior section suffers from the prisoner's dilemma. This dilemma happens since no private company has "*the incentive to contribute to the development of the standard because those who have not contributed cannot be excluded from enjoying the results*" [9, p. 7]. The author continues to explain that this dilemma leads to the so-called penguin problem by Forrell and Solaner (1986) [24] where no private company, or penguin in the analogy, dares to be the first mover.

To develop an SBR taxonomy requires a lot of different skills a single private company may not have. To quote Ojala et al. (2018) [9, p. 21]: "*Development of an SBR taxonomy requires deep skills in a number of areas spanning from accounting and statutory reporting to system interfaces and technical taxonomy work.*" This creates another barrier for the private companies to be a first mover. The single company has to have all competences on board to encapsulate to full project of creating the SBR taxonomy. In other words: multiple private companies need to create a working collaboration to develop the SBR, of which every other company in the country is going to make use.

The SBR taxonomy is part of the more general Information Systems (IS) as the information systems enable companies to streamline their processes within the company. As information systems can streamline all sorts of individual or company processes, the SBR taxonomy can streamline the business-to-government reporting processes by providing the general approach. As mentioned before, the adoption of such an information process can be challenging. Therefore the article by Perdana et al. (2018) [25] researched the information system adoption decisions in order to indicate the decisions needed to develop and adopt an SBR taxonomy. This creates an extension on the article by Ojala et al. (2018) [9] in developing the taxonomy.

The research done by Wang and Wang (2018) [26] has been mainly to the development of an XBRL taxonomy. They reiterate the necessity of different skill sets as presented by Ojala et al. (2018) [9]. Five different skill sets are presented in figure 3.1 together with a process model for the development of the XBRL taxonomy.

Wang and Wang (2018) [26] extend the research by Ojala et al. (2018) [9] by identifying two causes of taxonomy development: initiative development and passive development. Initiative development is done mostly or at least mostly initiated by governmental organizations. This is done to improve the quality of the business data they receive as this data needs more in-depth en detailed analysis.

This in-depth analysis creates also a more difficult planning, which is better suited for governmental organizations. The second cause, passive development, is done mainly by companies with respect to the regulation and rules posted by the supervising entities of the company. These entities can be governmental organizations, but also private sector regulation bodies. This creates an environment in which the company can develop the taxonomy in a simple planning with less workload and outside hindrances [26].

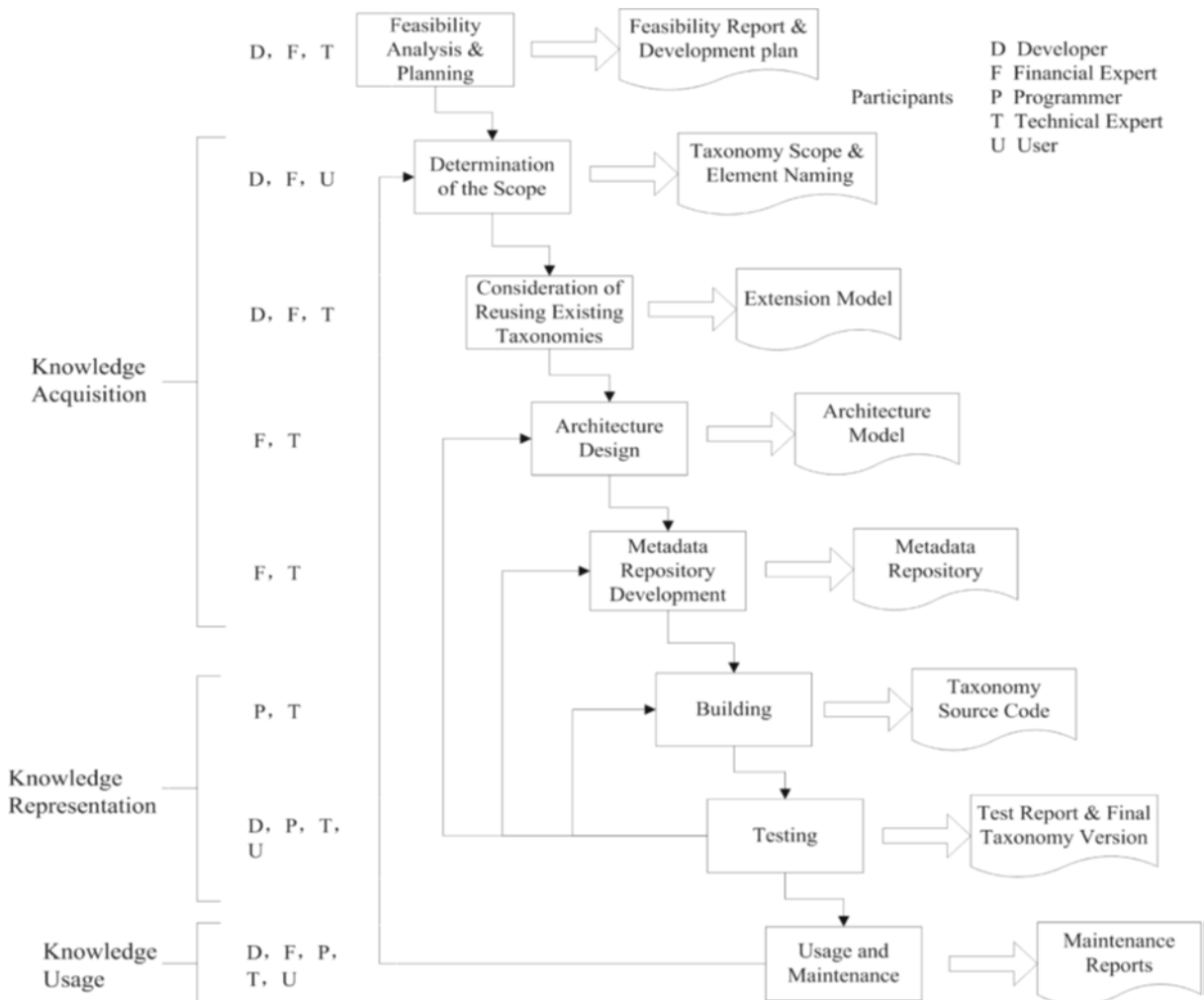


Figure 3.1: XBRL taxonomy development process model. Image from Wang and Wang (2018) [26].

The articles complement each other in case of taxonomy development as Wang and Wang (2018) [26] extended the research done by Ojala et al. (2018) [9], which is a specification of the research done by Perdana et al. (2018) [25].

### 3.2.4 XBRL Design

Using empirical studies on XBRL professionals, the authors Perdana, Robb, and Rohde (2019) [27] discovered the most interesting markers according to those professionals. These markers, also called Data and Information Quality points were extracted from different discussions on LinkedIn. Three of the most prominent LinkedIn groups on XBRL were used. These groups also had the largest follower base. Using the data from 2010 to 2016 several relevant data and information quality points were proposed for an XBRL framework. These 18 relevant data and information

quality points were derived from both the accounting and information systems fields, tying into the information systems article by Perdana et al. (2018) [26].

The data and information quality points for XBRL are needed in combination with the proposed model for the XBRL taxonomy development by Wang and Wang (2018) [26] as seen in figure 3.1. Using these 18 points, which are the most interesting data and information quality points according to professionals, the development of the XBRL taxonomy can be accelerated towards these 18 points. Additionally, more points can be added to the basic taxonomy to develop a total financial business report coverage. This can then be developed as the basis for a SBR system.

### 3.2.5 Inter-Governmental Data Exchange

The basis of SBR can also be used for the single direct input of data and direct transfer of data between public agencies. The main benefit of inter-governmental data transfer is the reduction of the administrative burden of the sending party. This party does not have to send their information to each public agency anymore, but can rely on the governmental data transfer between public agencies to provide each agency with its needed information [28]. Explained by Fowler (2016) [29, p. 7], there are four common barriers found against the inter-governmental exchange of data:

1. Turf and resistance to change: Agencies usually want to keep their relevance and preserve their control of costs and risks.
2. Data incompatibility: Mismatches between data architectures and taxonomies by different agencies.
3. Organizational structure and goals: data transfer requires staff that is able to maintain the transfer, as well as differences between agency goals and integration.
4. Institutional Complexity: (Legislative) Parties from outside the agency can influence decisions within the agency.

These barriers have to be overcome to achieve the effective inter-governmental data exchange.

### 3.2.6 Exchange Models

A generalization of SBR is the notion of Qualified Information Exchange [30], which is not restricted to business-to-government reporting or inter-governmental data exchange. The exchanges are based on a taxonomy designed as elaborated upon in section 3.2.3. When information is exchanged, the quality of the information can be lost. This can happen either during the exchange itself or during the assessment of the data, also known as assurance in financial data exchange. The assurance can happen on report level, but this results in secondary data analysis. To ensure full quality of the data, data-level assurance can be performed. The data is then inspected on transaction level instead of report level [31].

The areas of assured data and taxonomy can be inserted into dimensions for a maturity model. This maturity model will also be inspired by the Capability Maturity Model Integration and the Harvard Kennedy Maturity Model in terms of dimensions and categorization among the dimensions and among the levels of maturity [32, 33, 34].

## 3.3 Criticisms on Maturity Models

Maturity models (also mentioned as growth models) are widely found in literature, with popular models such as the CMMI and the Harvard Kennedy Maturity Model [33, 34]. However, as all models are approximations of reality, maturity models have certain shortcomings and pitfalls. Several articles in literature have focused on the shortcomings of these models and other types of

benchmarking. Because of these beforehand known shortcomings, the development of the maturity model for qualified information exchange needs to evaluate them in order to potentially circumvent the shortcomings. The following list of criticisms was compiled from the lists of shortcomings available in [35, p. 2226-2227], [36, p. 85] and [37, p. 173-174].

1. Generic models cannot be implemented in all governmental agencies. As agencies may have similarities, they are still likely to progress in different speeds due to political priorities or technical capabilities. A limited number of evaluated aspects remain vague and ambiguous due to their generality.
2. Most models are technological assimilation models. They report the ability to apply technology, but do not argue why.
3. Most models are a combination of descriptive and aspirational. There is no logical reason to believe that the highest stage is the best, as no models take politics or the impact of politics into account.
4. Many important technologies are kept outside of the purview of models (analytics, AI, cloud computing, etc)
5. Most models develop little to no consideration for change mechanisms or improvement support among the different stages of the model.
6. Most models lack theoretical and empirical base due to development in isolation. They do not include research methods, methodological guidelines and therefore remain intuitive, presumptive and speculative.
7. A limited number of dimensions are taken into consideration for the model. Most likely an amount of dimensions could be added. Hard to measure dimensions, such as socio-technical aspects, are most of the times left out. Non-concrete concepts or mental states also require proxy variables, which are context variant.
8. Any form of ranking system needs a final scale to create the scores. Usually there are no fixed or agreed rules for the scoring method available, which makes the scores context dependent.

The different criticisms are developed based on lists of past developed maturity models that are available in literature. The shortcomings need to be removed and evaluated as much as possible during the development of the maturity model for qualified information exchange.

### 3.4 Concluding Remarks

After summarizing the findings section, the most important details will be evaluated. This will be done in the order of mention in this literature review.

Starting with the business-to-government reporting section, it has become clear that there are many differences between the countries of Australia, the United Kingdom and the Netherlands. A single SBR system for all these countries is near impossible due to the differences in the organizational structure of the government of these countries. As Australia has a multi-level governmental structure, it is required to provide business data to all these level and its departments. In the Netherlands, a single governmental level requires the business data to be provided. Therefore a less complex single standard business reporting system can be and needs to be developed for this country without many exemptions. This also allows the government to control the data more upstream which generally increases the quality of the received data.

To create such SBR system, many hurdles need to be overcome. The principles that were proposed after a case study on the Dutch SBR were mentioned in section 3.2.2. These principles were partly challenged as they proposed a non-standard standard business reporting system, creating a

contradictio in terminis. However, these principles need to be accommodated as much as possible in the dimensions of the developed maturity model.

Moreover, the first mover hurdles from private companies to start developing the SBR taxonomy is also contributing to the transition hurdles. However, studies have proposed techniques to develop the taxonomy for an XBRL, which is used as the programming language of SBR to ensure compatibility between all business data providing and business data receiving instruments.

To use the received data efficiently between different public agencies, many hurdles need to be overcome. These hurdles possibly prevent the transfer of data between different public agencies, meaning that the sending party has to send their data multiple times. Dimensions regarding reusability of data will be developed from these hurdles.

Combining all the findings from all the articles, combined with the reported additional findings, the maturity model dimensions can be evaluated. Many studies research the aspect of setting up and developing a XBRL based taxonomy for the SBR, addressing the hurdles and tasks to successfully develop a system. However, practical studies about challenges or barriers in the business-to-government data transfer were not found. To develop an improved data transfer (or data delivery) system model, these challenges need to be indicated and solved. A maturity model can aid in the practical implementation of the solved challenges. Since such a maturity model is unavailable in literature, it needs to be developed before it can be used. The hurdles found in the inter-governmental data transfer might give indication in the hurdles that need to be overcome in the business-to-government data transfer. Additionally, the design of SBR and the design of the taxonomy might aid in the development of the maturity model as well as developing the dimensions of the maturity model. Several common shortcomings of maturity models are present in past developed maturity models. In the development of the maturity model for qualified information exchange these shortcomings need to be minimized as much as possible. The shortcomings need to be evaluated afterwards as well.





## 4. Data Delivery Chain Analysis

In order to develop the maturity model, a case study is done. The purpose of the case study is to find the challenges within the data delivery chain and to combat the challenges with fitting measures. These measures can then be prioritized in order to develop the key criteria for the maturity levels of the maturity model. However, before challenges in a delivery chain can be found, the current chain itself must be analysed. The current situation will be analysed in section 4.1. A stakeholder analysis of the chain will be presented in section 4.2. The challenges and measures will be presented in section 4.3, where these are found in the held workshops. Section 4.4 expands and validates the presented challenges and measures via interviews.

### 4.1 Current Situation

A model was used to familiarize the participants with the current situation. However, as a formal indepth model could create confusion for participants without the formal knowledge about such models, an approximated model was used as an overview of the situation. The approximated model will be shown in section 4.1.1, with the needed translations. To understand the current situation more indepth, a BPMN model was created using draw.io using the BPMN rules [13, 38]. This BPMN model is shown in section 4.1.2 with all its subprocesses.

#### 4.1.1 Approximated Model

The workshop was introduced via a presentation about the current delivery chain in order to create an equal knowledge about the delivery chain itself among the participants. The held presentation used figure 4.1 as model for the current delivery system. Figure 4.1 is in Dutch and made by the Advisor Taxonomy DUO. As figure 4.1 is quite crude, so a more indepth model of the current system is provided in section 4.1.2. The model signifies the needed double work for educational institutions. The Financial Statements need to be send on paper, together with the Board Report, the Auditor's Report and a Report of Findings, if applicable. An offer form is included in the package to DUO. Simultaneously, the Financial Statements have to be uploaded digitally via the Onderwijsportaal and the Digipoort, where a check and a formal XBRL validation happens, before sending it to DUO.

#### 4.1.2 BPMN Model

The full model requires more indepth look at the full data delivery system. Three different streams can be categorized: the self-composing Board of Directors, the Administration Offices Users and the Teamwise Educational Boards<sup>1</sup>. In collaboration with the Senior Process and Product

<sup>1</sup>The Teamwise Educational Boards are left out of the BPMN model. They make up a small part of the total educational boards and operate the same as a single education board, except that all boards send their financial information to a single entity prior to the model.

Figure 4.1: Dutch approximated model of the current data delivery model. It represents the double work that is done by educational institutions in delivering the necessary data. The data is delivered every year via an internal process (represented by the green circular arrows on the left) twice via two separate routes: via the paper route (upper green lines) the financial statements, the board report, the Auditor’s report and the report of findings are sent accompanied by an offer form. The second route is the digital route (lower green lines) where only the financial statements are delivered via the Onderwijsportaal and Digipoort in XBRL format. Created by the Advisor Taxonomy of DUO.

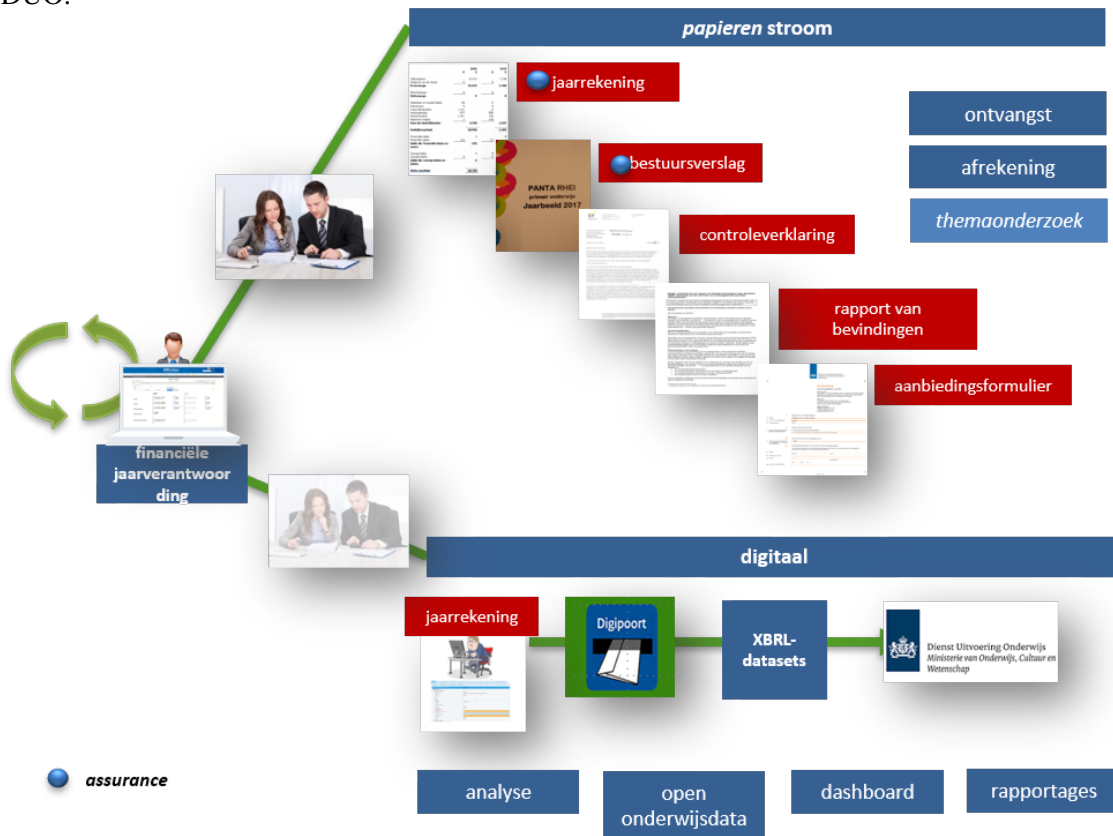
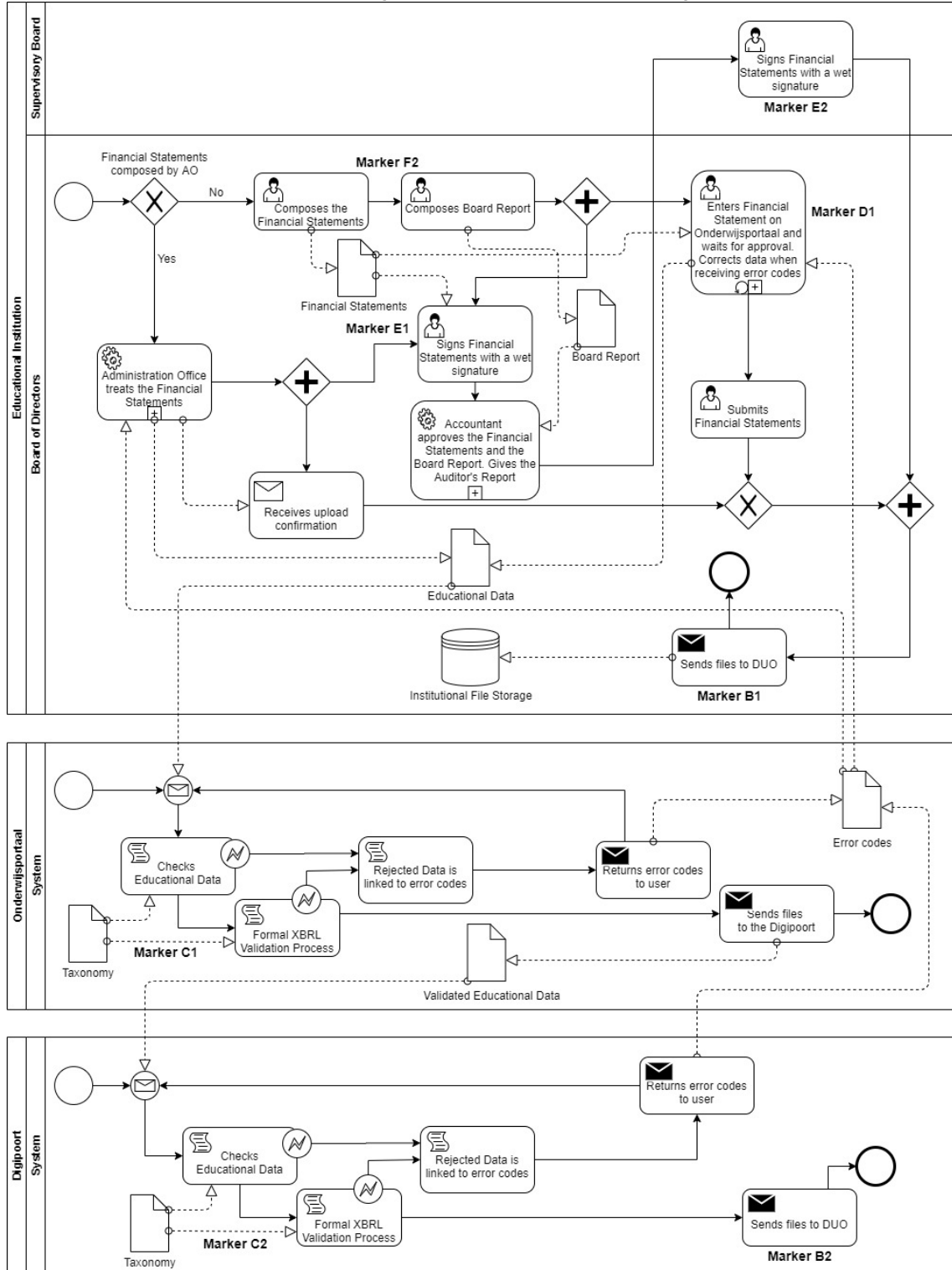


Figure 4.2: BPMN model main process. Three different pools designate the different stakeholders, with the educational institution divided into its Board of Directors and its Supervisory Board. Several markers are added for the designation of the different challenges in section 4.3.2.



Expert, the Advisor Taxonomy and a Specialist Report and Supervision from DUO, the model was completed. The model is divided in a main process and three subprocesses: the Accountant subprocess, the Administration Office subprocess and the Financial Statements Check subprocess.

The main process is indicated in figure 4.2, which starts at the Board of Directors, who are mandated to create the financial statements at the end of each year. Part of the boards creates the financial statements themselves, whereas other boards hire an administration office to treat the financial statements. When an administration offices treats the financial statements, it also produces the board report. This is the main split within the main process. If an administration offices treats the financial statements, the Administration Offices subprocess is the most important process. Therefore, two options are present: the board treats the financial statements themselves, or the administration office treats it. The two options will be explained in order.

Option 1: The board operates themselves, signified by answering the question "Financial Statements composed by AO?" with "No". The board has to compose the financial statements, the board report and sign these files with a wet signature. After the signature, the files are sent to an Accountant for the Auditor's Report and possibly a Report of Findings. At the same time after composing the board report, the financial statements have to be uploaded to the Onderwijsportaal. As certain operations may include faulty values, the Onderwijsportaal checks the data and sends approval or error codes. This step in explained in section 4.1.2. When an approval is received, the data is submitted.

Option 2: The administration office treats the financial statements. The administration office is sent the necessary data, possibly in a template. After the administration office has composed the financial statements as well as the board report, the files are send back to the board of directors for the wet signature before sending them to the Accountant, the same as in option 1. The administration office also sends a confirmation of upload to the board of directors after the financial statements are uploaded to the Onderwijsportaal.

The two options come together at the wet signature before the files are sent to the Accountant. The Supervisory Board also signs the files with a wet signature after the Accountant, completing the signature process. With either the submitted financial statements to the Onderwijsportaal or a confirmation of upload form the administration office, the paper files will be send to DUO as well as the institutionals own file archive storage.

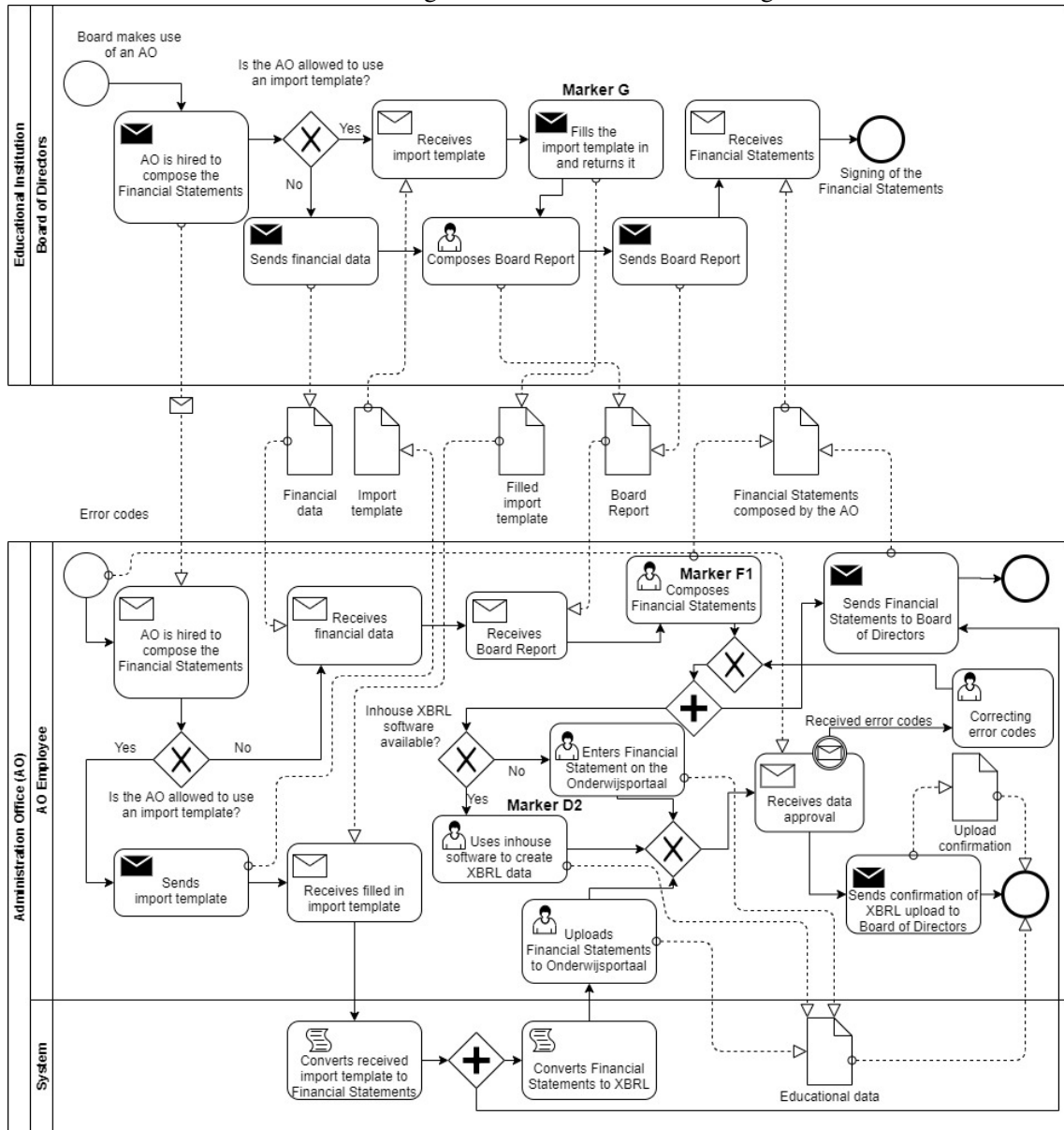
#### **Administration Office Subprocess**

When an administration office is hired to compose the financial statements and the board report, again two options are available. The difference is found if the administration office is allowed to use templates or not. This subprocess is shown in figure 4.3.

Option 1: administration office is allowed to use a template. A more automated process is created with the use of a template. The template is sent to the board of directors, which fill it in with the generated financial data. This can be filled in either manually or directly from the financial data software. After the template is returned to the administration office, the system converts the template to the financial statements and converts the financial statements to XBRL. The system returns the financial statements and the XBRL to an employee, which uploads the XBRL to the Onderwijsportaal and awaits approval and sends the financial statements back to the board of directors.

Option 2: administration offices is not allowed to use a template. Therefore, the financial data and board report is sent by the board of directors from which the financial statements are composed by

Figure 4.3: BPMN model Administration Office subprocess. Two different pools designate the different stakeholders, with the administration office divided into an employee and its system. Several markers are added for the designation of the different challenges in section 4.3.2.

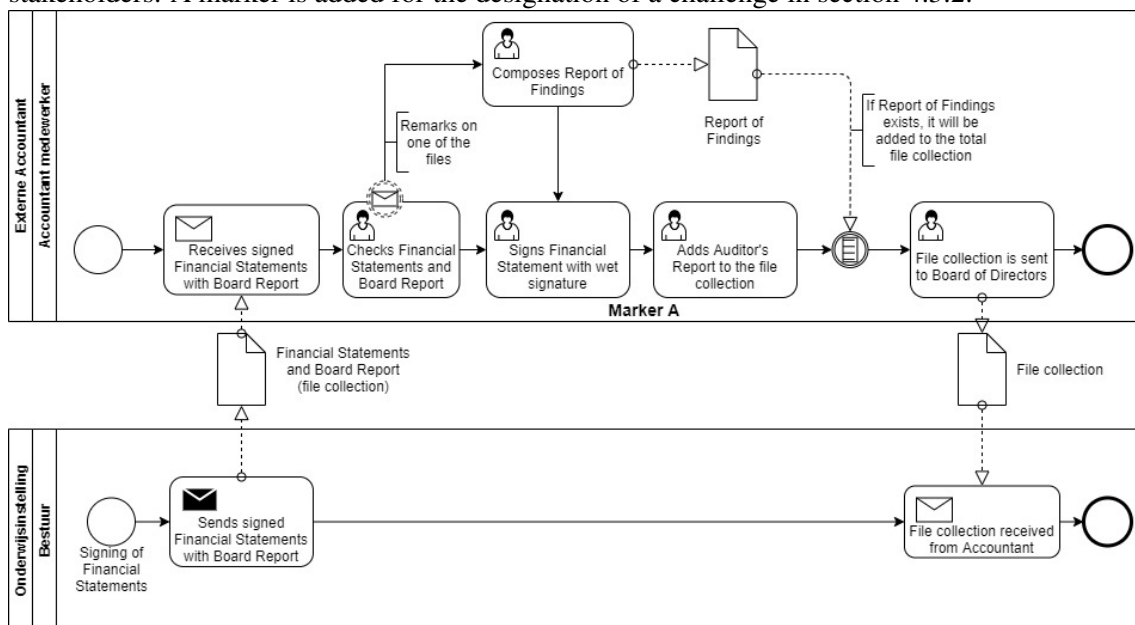


the administration office employee. The financial statements are both returned to the board and uploaded to the Onderwijsportaal. The uploading can be done in two ways: either it is entered manually or inhouse XBRL software is available to create the XBRL data from the financial statements. Approval of uploading is awaited.

Instead of approval, error codes can be received after uploading to Onderwijsportaal. Then the financial statement have to be corrected or re-entered to the Onderwijsportaal until approval is received. An upload confirmation is sent to the board of directors after the upload approval is received.

### Accountant Subprocess

Figure 4.4: BPMN model Accountant subprocess. Two different pools designate the different stakeholders. A marker is added for the designation of a challenge in section 4.3.2.



After the financial statements and the board report are signed with a wet signature by the board of directors, the paper files are sent to an Accountant. The accountant checks the financial statements on faults and/or unadmissible items within the files. If no remarks are found, the files are signed with a wet signature and an Auditor's Report is added to the file collection, which are returned to the board of directors. If remarks are found, a Report of Findings is composed, which is added to the file collection and returned to the board. This subprocess is shown in figure 4.4.

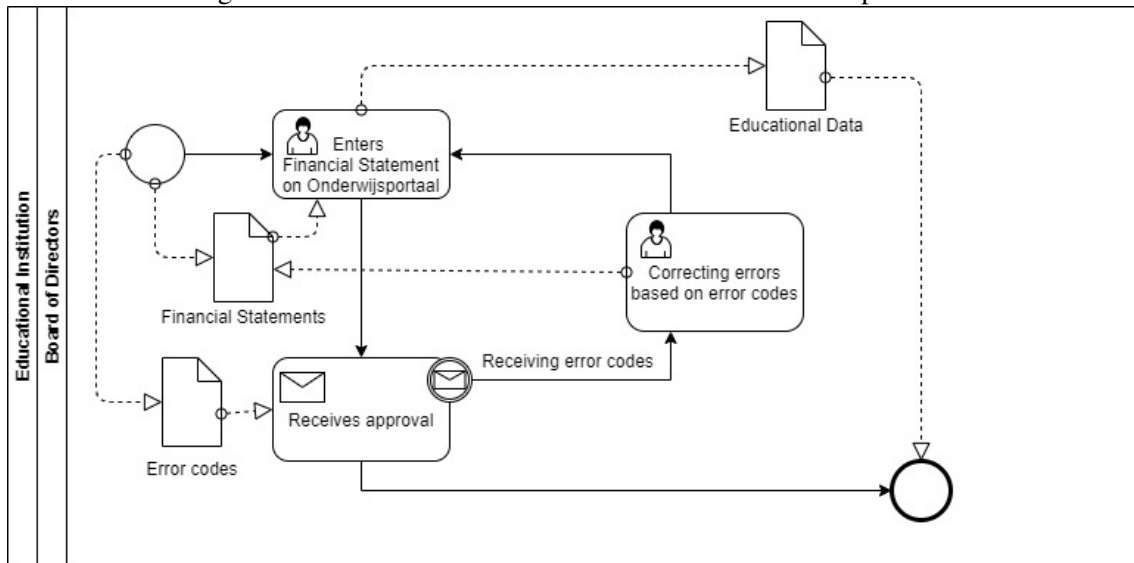
### Financial Statement Check Subprocess

A small conditional subprocess, as shown in figure 4.5 in which the board of directors repeat the financial statement upload and approval process until it succeeds. If an approval is unsuccessful, error codes will be returned from the Onderwijsportaal to the board. These standardized error codes contain the information on what is faulty in the financial statements and what to correct.

## 4.2 Stakeholders

The situation provides different stakeholders that have different motivations and needs: DUO, the educational institutions, the external accountants, the inspectorate of education and the ad-

Figure 4.5: BPMN model Financial Statement Check subprocess.



ministration offices. Apart from the stakeholders, other actors are: Logius, the Ministry of OCW (Education, Culture and Science) and the software suppliers. The stakeholders/actors from this multi-stakeholder problem are listed in table 4.2 with their position, power and resources. The information regarding their position, power and resources is obtained through interviews with experts within DUO, especially the advisor taxonomy, who has many relations to employees within the other organizations.

### 4.3 Workshops

To create a generalized maturity model, data has to be obtained. This is partly done via two workshops with different policy makers and members of the educational councils. The workshops were held on June 11<sup>th</sup> 2020 and July 9<sup>th</sup> 2020 via a combination of video call tool and a whiteboard workshop tool. The workshops were divided into three parts: Part 1 was intended to familiarize all participants with the current situation. Part 2 of the workshops were intended to generate challenges of the current delivery chain. The final part was intended to generate measures to these challenges as well as their priorities. These three steps are shown in sections 4.1, 4.3.2 and 4.3.3, respectively.

The data is partly obtained via interviews, which are shown in section 4.4. These deepening interviews check the data obtained by the workshops by questioning members of the educational boards themselves, as well as possibly create new insights from a different perspective on the process. Note beforehand: the workshops and interviews were done in Dutch, therefore all challenges, measures, remarks, etc. are translated to English, with the extra goal of remaining the nuance of the remarks.

#### 4.3.1 Participants

Four types of participants were invited to the workshops. These participants were selected based on their job, their influence on the process or the impact of the process on their job. The types can be translated to the policy makers from OCW, the executing staff from DUO, council members from the educational councils (also known as sector bodies) and remaining participants.

- **Policy Makers:** The policy makers of OCW are responsible for the actual policies regarding

Table 4.1: An overview of the actors and stakeholders with their position, power and resources. Here power is seen as the ability to influence changes.

Stakeholders (S) / Actors (A)	Position	Power	Resources
DUO (S)	In favour of more automated throughput data delivery. Strongly in favour of less error sensitivity and increased efficiency.	Little power.	Part of the Dutch state. Lots of expertise including connections to Logius, Digicampus, educational institutions and many more. Upholds the OCW taxonomy.
Educational Institutions (S)	Mandated by law to provide educational data to DUO. In favour of more user-friendly data delivery.	Little power, must comply to OCW. Little diffuse power against OCW.	Funds from DUO, many connections with each other and via sector bodies.
External Accountant (S)	In favour of automated data delivery and digital assurance as it simplifies their throughput time.	Moderate power, relatively large competition. Blocking power to educational institutions.	Necessary and expert financial knowledge.
Administration Offices (S)	Reluctant to change in automated data delivery. Can make the administration office obsolete.	Little to no power.	Strong connections with educational institutions.
Logius (A)	Facilitates the governance of SBR organizations. Shared service centre of SBR. Slightly in favour of automated data delivery.	Moderate power.	Part of the Dutch State. Lots of expertise on software and ICT. Connections with Digicampus and Ministry of OCW.
Ministry of OCW (A)	Slightly in favour of automated data delivery as it can decrease the needed funds for processing due to increased efficiency.	All educational parties have to comply with policies and regulations made by OCW. Production power.	Part of the Dutch State. Many connections to DUO, Logius, Accountants, Inspectorate of Education and educational institutions.
Inspectorate of Education (S)	Slightly in favour of automated data delivery as it can promote quick data analysis. Strongly demanding assurance on data.	Large power as supervising agency of both institutions and accountants	Part of the Dutch State. Many connections to DUO, Ministry of OCW, institutions and accountants.
Software Suppliers (A)	In favour of automatic data delivery, yet reluctant to invest.	Moderate blocking power in providing the software. Relatively large competition.	Independent market. Relations with Digicampus.



the delivery and regulate the legal part of the delivery chain. Their priority is the efficiency and reliability of the delivery chain.

- **Executing Staff:** The executing staff from DUO are responsible for the throughput of the data within OCW and also the communication to the educational institutions. Their priority is the reliability and ease of the data throughput.
- **Council Members:** The council members of the different educational councils represent the educational institutions in their domain. Their priority is the reduction of the administrative burden of the institutions and the creation of clear definitions to reduce the differences between interpretations.
- **Remaining Participants:** The remaining participants are participants from Logius, who uphold the SBR focus of the Dutch Government, as well as software suppliers, who have to create the automated delivery chain.

The policy makers and executing staff were present at the first workshop to gain insight in the challenges from their perspectives. However, due to both lack of participating and to reduce influences among parties, the council members were invited to a second workshop with the same setup. Therefore two workshops were held, but as these workshops can be seen as parts of a single workshop, they will be regarded as such in the next sections. The workshop was divided in three parts: Part 1 introduced the current delivery chain, the goal of the workshop and the participants. Part 2 surrounded the challenges and allowed participants to input their challenges and other dislikes about the current delivery chain. Some points were explained more in depth when necessary or asked. Part 3 focused on the measures for the brought up challenges. These measures were also discussed and explained, ending in a vote about the priority of the measures.

The interviews were held with three members of different educational boards. They were set up similarly to the workshops with an introduction about the delivery chain, a part where the interviewee raised challenges as viewed by them and a final part how to combat the challenges and which challenges were the most important parts.

### 4.3.2 Challenges

As said at the start of this chapter, part 2 of the workshop was intended to generate challenges of the current delivery chain. This section will elaborate on the obtained challenges. Two organized lists of all the obtained challenges can be found in appendix A.1 with an overview of all the obtained challenges on the original board. The challenges are divided into four different categories: organizational challenges, technical challenges, legal challenges and remaining/unknown challenges.

Assessing the challenges several things are noticed. Many participants named the term of digital delivery only, removing the need of the paper delivery to DUO. Transforming to the digital delivery, many participants requested the use of digital assurance by the accountants. This removes the need of paper documents, as well. This is complemented by the perceived inflexibility of the taxonomy. The parties perceive the taxonomy as unchangeable, therefore creating inadequate adaptability to future needs in terms of extensions and changes.

To extent the perceived unchangeable taxonomy, the current digital delivery line (via XBRL) is unable to interconnect with reporting and benchmarking software. The participants argued that is due to the incomplete taxonomy. This mandates a need for inefficient transfer or relocation of data to the connecting software. The perceived inadequate software interconnectivity is also seen in the wish for more usage of the received educational data. The difference between data on educational board level or school level creates different data, but also different amounts of data.

A general remark of the policy makers of OCW is the lack of oversight of the delivery process. They also named this remark the challenge in answering the following questions: How can we use this data to create solutions for the teacherproblem<sup>2</sup>? How can we use this data to mark the best school of the Netherlands<sup>3</sup>? And how can we use the financial data to gain insight in the effectiveness of the made policies.

This oversight can also be complemented by a remark by the council members: is there enough political or board support for the digital cause? Is its priority high enough? Political or board support is necessary for the digitalization to mature within an organization. In order to develop the support, several types of analysis and recommendations can be made. Numerical and monetary analyses usually are significant more impactful than vocal recommendations.

### Mapping of the Challenges

Twelve markers were added to figures 4.2 - 4.5: markers A to G. These markers are located at a process step in the BPMN model of the data delivery chain and are linked to challenges described in the previous section. The markers and their process steps will be explained in combination with their respective challenges.

**Marker A** is located in the Accountant Subprocess of figure 4.4. It represents the wanted digital assurance. The process steps containing the 'Wet Signature' and the 'Auditor's Report' require the accountant to print the documents and sign them by hand, then add the signed Auditor's Report to the file collection and send them back. These steps can be digitalized by adding a digital variant of the Auditor's Report, therefore allowing the accountants to sign documents digitally. The digital signature functions for both signing the financial statements and as the Auditor's Report.

**Marker B1, Marker B2, Marker D1 and Marker D2** represent the interconnectivity between the delivery chain and the 'surrounding' software, meaning the software that connects to the beginning or the end of the chain. The software before the beginning of the chain is the financial software of the educational boards. The financial software is used to create the financial statements and possibly more. However, these software packages usually cannot use the XBRL format of the onderwijsportaal or the digipoort. Therefore, the data must be manually entered by the board itself (Marker D1) or by the administration office manually or via separate inhouse XBRL software (Marker D2). Marker B1 and marker B2 are located at the 'Send files to DUO' process steps in both the paper route (Marker B) and the digital route (Marker B2) in the BPMN model main process. Both Markers indicate the challenges that occur at sending the data to DUO. At the digital route (Marker B2), DUO is mostly not able to use the XBRL data to its maximum. In the accountability process steps within DUO, the XBRL data has to be modified to be usable in reporting software as the reporting software is not able to use the XBRL format itself. These steps can be improved by developing addons for the major financial software packages and DUO reporting software for XBRL, allowing all programs to use the same format and therefore improving reuse. At the paper route (Marker B1), the paper files have to be triple send to DUO on single sided papers. This is needed for DUO to be able to scan the documents properly, after which they are used as PDF formats or retyped to the DUO system. Marker B1 also represents the full digital delivery as the part paper route, part digital route must be transformed into a full digital route.

**Marker C1 and Marker C2** represent the challenge of the perceived inflexibility of the taxonomy. The markers are located at the 'Formal XBRL Validation Process' of the Onderwijsportaal (Marker

<sup>2</sup>The Netherlands have a significant lack of teachers for primary education as well as middle school [39].

<sup>3</sup>Each year the Inspectorate of Education gives out the predicate of Excellent School to schools that excel in certain areas [40].

C1) and the Digipoort (Marker C2). At these locations the taxonomy is used as the validation base for the XBRL data files. However, if the taxonomy is insufficiently build, the validation will be directly affected and be possibly faulty. Different interpretations of the nodes within the taxonomy semantics can create differences in files, with miscommunications or financial miscalculations as a result. A single interpretable taxonomy is necessary for full validation and transfer of information between different parties to ensure all parties interpret the data equally and as intended. In order to keep improving the taxonomy, the development has to be flexible. The flexibility is necessary to keep up with changes in the law and wanted information. If new information is wanted over the same data delivery chain, the taxonomy must be adapted to incorporate the new information nodes.

**Marker E1** and **Marker E2** represent the digitalization of the signature, given by the board of directors of the educational institutions (Marker E1) and the supervisory board (Marker E2). The digitalization of the signature is needed for the full digital delivery challenge. For throughput to be maximized, a digital signature, similar to the digital signature of the accountant, can improve throughput and decrease handling time of the financial information. A token can be used to generate secure code combinations for security of the signature.

**Marker F1** and **Marker F2** also represent the full digital delivery. The markers are located at the composition of the financial statements and board report by either an administration office (Marker F1) or the board of directors (Marker F2). For full digital delivery, the financial information can be transformed to the financial statements by hand or via (an add-on of) the financial software package. This removes the need for manual input or calculation of financial numbers, reducing error sensitivity. **Marker G** is an extension to Marker F1 and F2 in case of the use of an administration office that is allowed to use templates. The filling of the import templates by the board of directors can be digitalized by connecting the export of the financial software to the import template, therefore removing the need of manual input and also reducing error sensitivity.

### 4.3.3 Measures

To combat the challenges, the participants were asked to think of measures against one or multiple challenges. An organized list of the measures can be found in appendix A.2 with an overview of all the obtained measures on the original board. The measures were not restricted to each own challenges, everyone was motivated to create measures for each others challenge. This cooperation is also the main result of the measure board: each organization suggested that increased cooperation among stakeholders is a necessity. Many challenges are tackled via this measure and several measures are special cases of this main measure.

The need of digital assurance was tackled by starting a regular cooperation with accountants to indicate their needs in the digital assurance and the transition towards it. This cooperation is also necessary to formalize the process and elaborate on the concept. The development of the taxonomy is another high priority measure: it is requested that parties cooperate in the development, where all the relevant parties get to elaborate on their priorities and ideas. This means including both sending and receiving parties in the development process.

The challenge of direct and purely digital delivery was tackled by introducing the notion of maximal accessible and reuse of data. This way the sending party should never send the data twice or to different requesting parties. A proposed solution to this is the introduction of full system-to-system network. This way the financial data of the delivering parties is delivered directly from the financial software at the educational institution to DUO. This also includes the interconnectivity between different user software packets. It was suggested that different types of

software cannot interact with the XBRL data. Therefore cooperation with software suppliers and consultants is necessary to integrate the reporting and control software with the XBRL data. The requested extension for non-financial data, including formal XBRL validation, can then also be discussed and integrated. These different types of measures could lead to a more cooperating government and integration of other parties in the progress, possibly combining the best of these worlds.

To apply these measures, it is useful to prioritize the measures and therefore creating an order in which the measures should be implemented. The prioritization was done during the first workshop with the Miro internal voting system. All participants were allowed to cast their vote on the given measures, creating the priority. The votes created four different priority steps. The full list of measures in appendix A.2 also indicates the priority which is given. The most prioritized items are listed here as well:

- Integration between XBRL data and reporting software by cooperation with software suppliers and consultants.
- Using XBRL for more than just financial data, possibly extending the taxonomy if necessary.
- Creating a protocol for direct exchange of data with external parties to improve the transfer of data.
- Cooperation between OCW, councils and other parties to discuss the best approach for different datasets.
- Involving relevant stakeholders in the XBRL development process.

Three of the most prioritized items consist of the word cooperation itself, or a synonym of the word. The other two items require cooperation in order to develop a software program that satisfies the needs of all stakeholders of these programs. This also signifies the need for cooperation between the different parties and the need for interacting software. The interacting software will remove manual tasks which inherently increases efficiency, assuming the software works accordingly. The development of this software will also allow any operator to give insight in the process. Indicators of which data is processed at certain points allow overseeing bodies to check the data.

The second workshop did not employ the embedded voting system, but prioritized the measures with the participants in conversation. As the second workshop had significantly less participants than the first workshop, the method of open conversation was employed. This resulted in more indepth measures, but also more intense wishes. One of these more intense wishes was the suggestion of digitalization itself. The participant noted that it should be a necessity, similar to the tax statement delivery chain. Therefore it has to become mandatory by law for educational institutions to deliver their data digitally. Another measure is to make the digital delivery mandatory for every new governmental tender about financial or reporting software. The obligation of a standard format requires interaction with or integration of this standard. The interaction or integration for XBRL as standard could be done on three different levels: The Bolt-On Approach, the Build-In Approach and the Deeply Embedded Approach [41, 42, 43].

The participants also suggested the use of numerical or monetary analyses in order to increase political support for the digitalization, as was mentioned in section 4.3.2. Finally, the participants suggested the use of a single delivery chain for all data required by all public agencies and other governmental departments. This requires some sort of governmental data platform in order to either distribute the needed data to every public agencies or to allow the public agencies to download the data from the platform whenever the data is needed.

## 4.4 Interviews

The interviews were held separately with three members of different educational boards. They were set up similarly to the workshops with an introduction about the delivery chain, a part where the interviewee raised challenges as viewed by them and a final part how to combat the challenges and which challenges were the most important parts. The interviewees were chosen based on availability and cooperativeness as not all known available board members responded to contribute to the challenges and measures. The board members were known via the advisor taxonomy or other DUO employees.

All interviewees were in agreement that the current delivery chain is 'unnecessary more work' and 'not of this time' and must be fully digitalized. Furthermore, they mentioned equal challenges and measures as were proposed during the workshops. Some examples are: (1) the usage of taxonomy with singular defined elements. The taxonomy itself is not used by the educational institutions, but the elements are. (2) Cooperation between DUO and educational institutions is experienced as very desirable. (3) A standard format would increase possibilities for benchmarking as all financial software among institutions can differ significantly. (4) If the delivered data contains problems or data is missing, the response is experienced as very slow. *'it could take months before a response is given,'* as one interviewee mentioned.

The main points were summarized by an interviewee in four bullet points:

- Internationalization; usage of internationally accepted accountancy structures and standards may increase compatibility with other countries as well as usage of an already known and tested standard.
- Harmonization; increasing consistency among different departments within the same organization. Cooperation among departments in order to help the organization as a whole.
- Digitalization; usage of fully digital exchange mediums. Is seen as necessary for future progression and improvement.
- Rationalization; maximal reuse of existing data is mandatory for progression and reduced administrative expenses. Existing data should not be delivered or requested again if it already is available at the receiving site.





## 5. Maturity Model

*Arbetsklader renas fran tungmetaller, ©mynewsdesk [44]*

Inspired by the Capability Maturity Model Integration (CMMI) as proposed by Paulk et al. (1993) [33] and the Harvard Kennedy Maturity Model [34], a maturity model is proposed for the qualified information exchange of a delivery chain. Such a model is presented in several stages of maturity, denoted as levels. Followed by the convention started by the CMMI, five levels of maturity are proposed [45]. As shown by the mentioned maturity models, a maturity model consists of several items known as dimensions, which denote the different areas within the model. These dimensions are the different areas of possibilities where the model can describe the maturity level of the delivery chain. Each dimension has several different options, which explain the possibilities within that dimension. Furthermore, the options can also be explored to prescribe next steps in order to progress within the model to a level deemed more mature. The different options are placed inside a matrix which describes what option corresponds to what level for each dimension. Therefore, improving certain dimensions can increase the maturity level according to the developed model. It must be remembered that different option improvements do not always guarantee a level improvement and that the different dimensions are inter-connected and are dependent on each other. Some dimensions cannot be improved without improving another dimension before it (simultaneously improving both the 'parent' dimension and the dependent dimension could be done in certain cases, and is mandatory in other cases).

The usage of the model requires some conditions in order to be accurate. These conditions are mentioned in section 5.1. The dimensions used for the developed maturity model are listed in section 5.2. This section describes the different dimensions and their options and of which levels these options are part of. In section 5.3 the levels are explained in more depth. Since no model is perfectly adaptable to the reality, this model has certain limitations. The limitations are discussed in section 5.4.

### 5.1 Conditions

The model requires several conditions in order to be used in an accurate fashion. The conditions are required for all levels of maturity and therefore are always prerequisites. These conditions are necessary since if these fail, certain (privacy) sensitive or other regular actions cannot be performed legally. Main conditions are the legal aspects of the digitalization of the data exchange: the cybersecurity and the privacy of the users. The model upholds the law (Network and Information Systems Security Act 2018 & General Data Protection Regulation Act 2018) surrounding these two legal conditions and therefore in all levels the cybersecurity and privacy must be guaranteed [46, 47]. Furthermore, the upcoming Modernization of Electronic Administrative Traffic Act 2020 is also a continuous condition in the model [48].

In anticipation of the Available Knowledge of Taxonomy and Software dimension in the next

section, a condition is necessary for this knowledge. Continuously throughout the maturity levels of the proposed maturity model, the gathering of necessary knowledge is key. Available knowledge must be increased in order to progress to a more mature level, because without this knowledge, the upcoming types of technology cannot be developed or operated. A condition is that the knowledge is gathered in a systematic manner. Several manners can be used in order to gather the necessary knowledge to train staff, which is necessary in order to operate the systems and applications of the more mature levels. Possibilities are:

- A specialized knowledge centre for SBR or Qualified Information Exchange
- A specialized education path for SBR or Qualified Information Exchange in cooperation with an university or college
- National Academy for computerization and government

## 5.2 Dimensions

The list of dimensions was composed with the help of the previously mentioned models, literature [5, 30], as well as interviews with, among other persons, a Business Analyst at Logius, the Advisor Taxonomy at DUO, an independent researcher at TU Delft and the author prof. Verkruisje from [31]. Therefore, the dimensions are believed to encompass the whole qualified information exchange for a financial data delivery chain.

As shown in figure 5.1, the dimensions are categorized in five categories: exchange dimensions, data dimensions, data quality dimensions, standardization dimensions and governance dimensions and are listed in sections 5.2.1 - 5.2.4, respectively. The sections contain a table with the options of each dimension in that category presented. The options are presented with their proposed maturity level index. The level index is the level of which that option is part of.

### 5.2.1 Exchange Dimensions

The first set of dimensions are the dimensions that encompass the exchange of data itself. All dimensions are dependent on the first dimension of this category: the Data Exchange Medium dimension. This dependency is due to the availability of the digital exchange medium, which is required for certain options.

1. The Certainty of Identity of Supplier and Intermediary dimension depends on the exchange medium as the exchange medium is necessary to accomplish certain authentication methods. E.g. there can be no electronic signature without a digital exchange medium.
2. For the Assurance dimension applies the same reasoning. There can be no electronic signature for the digital assurance if there is no digital exchange medium.
3. The need for Human Intervention also depends on the exchange medium, as no system interaction is needed if no system is present.

The options for all dimensions in this category have the most digital option as their most mature option presented. The digital option is seen as most mature by literature due to the reduced dependency on humans and human interaction [5, 30]. The inbetween option all require a partly digital option, but are not fully digital, therefore requiring more humans or human interaction. This creates their less mature state comparing to the fully digital options.

### 5.2.2 Data and Data Quality Dimensions

The second set of dimensions are the dimensions that apply to the data itself or to the quality of the data.



Figure 5.1: Overview of all dimensions. The arrows indicate a dependency between the dimensions and are pointed from parent to child dimension. The dotted enclosed areas indicate the five different categories.

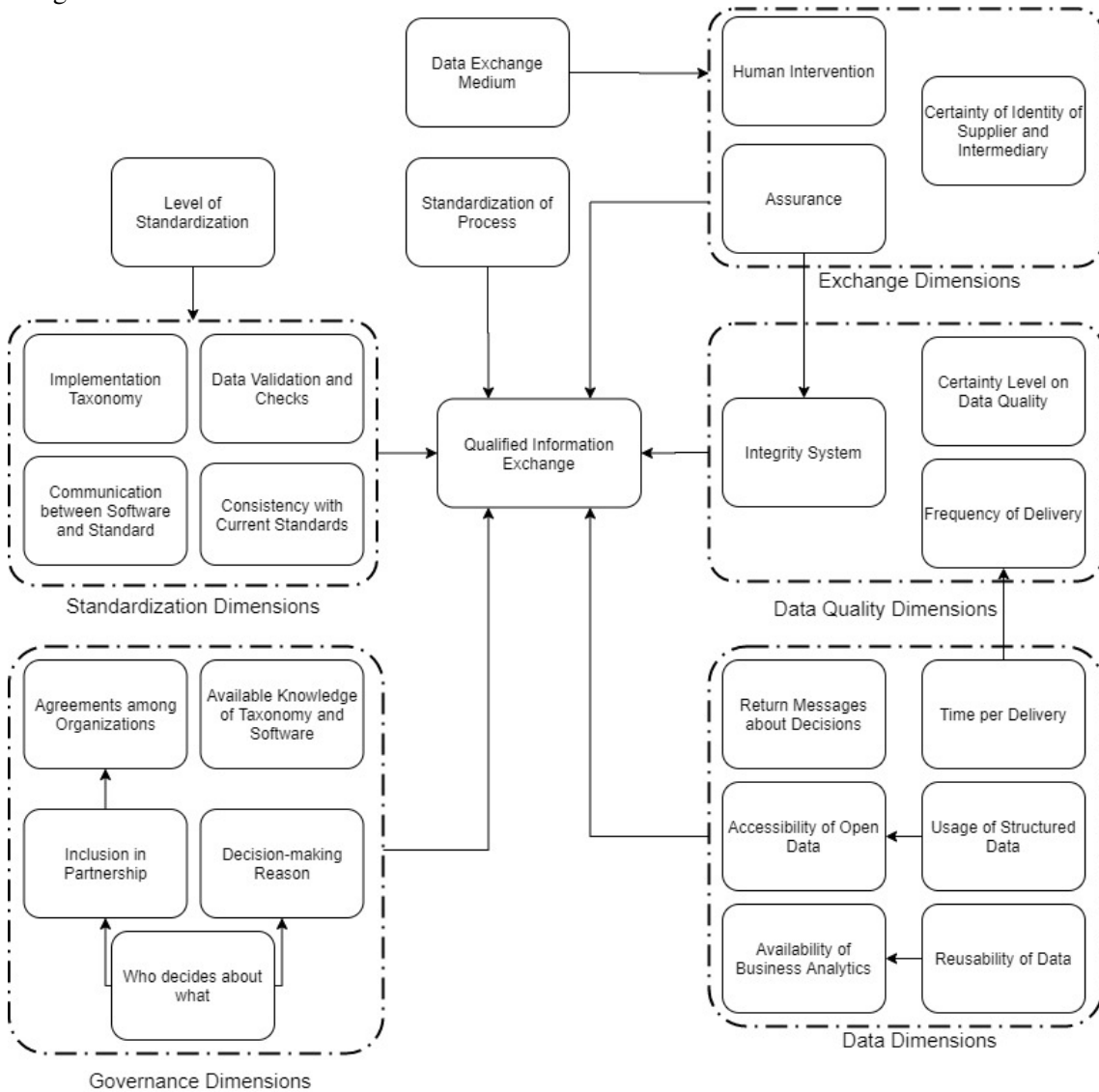


Table 5.1: Dimensions depending on the medium of exchange of data. The different options are given for each dimensions as well as an their proposed level index.

Exchange Dimensions					
Dimension	Level 1	Level 2	Level 3	Level 4	Level 5
<b>Data Exchange Medium</b>	Paper via postal service	Mixed delivery	Digital delivery		
<b>Certainty of Identity of Supplier and Intermediary</b>	Wet signature	Scanned wet signature	Qualified electronic signature		
<b>Assurance</b>	Paper assurance	Paper assurance with digital delivery	Digital assurance with qualified electronic signature		
<b>Human Intervention</b>	Manual delivery (H2H)	Data entering on a portal (H2S)	Data import from a file (H2S)		Direct data forwarding (S2S)

The Time per Delivery dimension depicts the average time that is necessary for the delivery in total. The time from combining the financial data to the end of the delivery is counted. Dependent on the Time per Delivery is the Frequency of Delivery dimension, which states the frequency at which the delivery is made to the requesting party. To keep it feasible, the frequency must allow the sending party to complete a delivery cycle before starting a new cycle. A higher frequency, and therefore a lower time per delivery, allows for more continuous monitoring, resulting in more accurate data and is therefore seen as more mature [30]. An increased frequency also allows for improved monitoring, increasing the quality of the delivered data.

Open data is regarded as information that is publicly accessible and available. It must be complete, primary, timely, accessible, machine readable, non discriminatory, open standard and open licence before it can be called open data according to the Dutch Government [49]. In the context of this research, open data is tested on availability and accessibility. All other requirements, except open standard, are subject to the data itself and can therefore not be controlled by a maturity model. As shown in past research, open data creates positive social and economic effects, therefore available and accessible data is more mature than inaccessible or unavailable open data [50, 51, 52]. The remaining requirement for open data, open standard, is treated in the dimension Usage of Structured Data.

Decisions about the data delivery are processed at the requesting party and can contain faulty deliveries. Communication about these deliveries is depicted by the dimension Return Messages about Decisions. As humans currently may be able to understand more complex questions, many errors in deliveries can be filtered by AI. Therefore communication about the decisions made based on faulty deliveries, can be done via error codes or via direct AI communication. As human interaction is often seen as the weak link in a process and the AI option requires the least amount of human interaction and is the most automatable, it is seen as the most mature option [5]. Using

automated semantic recognition and possibly parts of the semantic web, AI research can progress to understand more complex cases and return decisions made about erroneous deliveries [53].

The file format in which the data is transferred can have different properties. Different file formats have different levels of structuredness. In the context of this research, a structured file format is defined as a file format that contains the data of the file and the information about the file. However, a structured file can still be used without the intrinsic properties or information of the file type. Since intrinsic properties allow automation, therefore reducing the need for human interaction, more usage of intrinsic properties is seen as more mature. File format XBRL is seen as a structured file format even with the *Instance Document* that is sent with the files in the delivery. This instance file allows usage of the taxonomy without sending along the complete taxonomy. The reduced structuredness is compensated with reduced delivery size.

The Reusability of Data dimension depicts the technical ability to reuse data that is already present at the requesting party. When unchanged data is reused from previous deliveries, it is not required to be sent again. This decreases the delivery size and therefore the usage of the delivery chain. However, more data storage is needed to store the data from previous deliveries. Better reuse of data with a larger part of the organization is seen as more mature as less information needs to be resent. The previously delivered data can also be used in business analytics. The Availability of Business Analytics dimension is therefore dependent on the reuse of data and depicts the possible analytics within the delivery chain or even surpassing the chain.

Data quality is important in the financial data transfer, as incorrect financial information could lead to false financial statements and (accidental) fraud. The quality on data can be inspected on multiple sublevels. Firstly, the frequency of delivery, as mentioned before. Secondly, the certainty at which the data quality is checked. Finally, the integrity of the system in which the data is checked. The dimension Certainty Level on Data Quality has three options in ordinal scale for the level of assurance: report level, system level and data level. Report level assurance is widely used in financial statement assurance as financial statements are effectively report of the financial data. A more mature system would be to audit the system in which the data is transfers. Auditing the system of the data transfer could recover some intricate details about the report that were previously invisible. An even more mature level assurance is the data level assurance, where assurance is done on the data (e.g. the transactions) itself. The transactions will then be audited without any previously executed procedures on the data. This can increase the data quality significantly and is therefore chosen as the most mature option [31].

To ensure the quality of data, the integrity of the assurance system is important. The System Integrity dimension has three options: (1) No system available, which is consistent with the lack of digital assurance. (2) System complying with industry standards, in this case the International Standard on Assurance Engagements (ISAE) No. 3402, *Assurance Reports on Controls at a Service Organization* standard [54]. Another quality mark is the Keurmerk Zeker OnLine, which certifies the audit systems [55]. (3) And finally the transition from accountant assurance to system integrity, where the quality of the system upholds the quality of the source data, combined with checks by an IT auditor. The system integrity option is seen as more mature than the accounting option, following the reasoning from the previous dimension, Certainty Level on Data Quality.

### 5.2.3 Standardization Dimensions

The third set of dimensions are the dimensions that encompass the standardization in the delivery chain. All dimensions are dependent on the first dimension of this category: the Level of Standard-

Table 5.2: Dimensions regarding the data itself. The different options are given for each dimensions as well as their proposed level index.

<b>Data Dimensions</b>					
<b>Dimension</b>	Level 1	Level 2	Level 3	Level 4	Level 5
<b>Time per Delivery</b>	$\geq 7$ months	Between 6 and 5 months	Between 4 and 2 months		$\leq 1$ month
<b>Accessibility of Open Data</b>	Unavailable open data	Available, inaccessible open data		Available, accessible open data	
<b>Return Messages about Decisions</b>	Individual processing	Processing via error codes			Direct AI processing
<b>Usage of Structured Data</b>	No usage of structured data	Usage of structured data as flat data		Usage of structured data including its intrinsic characteristics	
<b>Reusability of Data</b>	Non-reusable		Reusable within a single agency	Reusable within all agencies	Reusable with parties outside the government
<b>Availability of Business Analytics</b>	No analytics		Analytics within a single chain		Chain surpassing analytics

Table 5.3: Dimensions regarding the quality of the data. The different options are given for each dimensions as well as their proposed level index.

<b>Data Quality Dimensions</b>					
<b>Dimension</b>	Level 1	Level 2	Level 3	Level 4	Level 5
<b>Frequency of Delivery</b>	Annually with assurance		Semi-annually with at least once per year assurance	Every four months with at least once per year assurance	Monthly with assurance
<b>Certainty Level on Data Quality</b>	Report level			System level	Data level
<b>System Integrity</b>	No system available		System complying with industry standards	Transition from accountant assurance to system integrity	

ization dimension.

If a standard format is used, it has to interact with the different kinds of software within in the delivery chain. The Communication between Software and Standard dimension depicts that aspect. Since a standard is necessary to communicate between software and a standard, the option No standard is seen as least mature. Increasing the amount of usage of the standard format increases the maturity of the options. This can be done in three steps: The Bolt-On Approach, the Build-In Approach and the Deeply Embedded Approach [41, 42, 43]. Therefore, using the standard format only for exchange (bolt-on), thus reducing communication to only a change of file type, is less mature than using the standard format for import and export (built-in), thus implying that the software can directly communicate with the standard format without changing the file types. Direct S2S communication would allow direct communication between software using the standard format, which is seen as the most mature option (deeply embedded).

A taxonomy implies the use of a standard as a standard format is required to use a taxonomy. The dimension Implementation Taxonomy depicts the parts of the delivery chain where a taxonomy is used. A taxonomy creates an environment in which business rules surrounding the elements in a standard format can be formalized. This implies that an increased usage of a taxonomy is a more stabilized delivery chain which is also easier to maintain due to the centralized place of the business rules.

Data that is following a standard format still needs to be validated. To maintain data quality checks and validations must be performed on the data. These checks can be done manually, which requires intensive human interaction, or done automatically at the portal or at the delivering party. As mentioned in section 3.2.1, an increase in data quality is achieved when the data validation is implemented more upstream [20]. Therefore automatic validation at the delivering parties is seen as more mature than digital validation at the portal or manual validation at the receiving party.

Even if a standard format is used, the standardization can be different within a single delivery chain. The dimension Consistency with Current Standards depicts this aspect and expands it to other delivery chains within the organization. As explained in section 3.2.5, there are common barriers to obtain inter-governmental exchange [29]. These barriers can be expanded to (parts of) delivery chains within an organization as governmental agencies act like departments within a single organization (the government itself). Especially the data incompatibility barrier is important in the context of this dimension. Therefore, more consistency and usage of a single standard format among delivery chains is seen as more mature.

A standardized format can only be used to its full extent if the process using the standard is standardized as well. Standardization is here defined as having more measurable specifications, since more specifications allow for less variations and therefore increase the standardization. This also applies to the different processes: more use of standardized processes in a delivery chain is seen as more mature. SBR is an example for a heavily standardized submit & accept process, but has currently less to zero specifications for the preparation, processing or reporting of data. A common data model for data preparation, data processing and data reporting can help in the standardization of these process steps.

#### 5.2.4 Governance Dimensions

As governance dimensions may be complex, three guidelines are used. They are listed as three questions that effective IT governance should always answer [5, 56]:

Table 5.4: Dimensions regarding and depending on the used standards within the chain. The different options are given for each dimensions as well as their proposed level index.

<b>Standardization Dimensions</b>					
<b>Dimension</b>	<b>Level 1</b>	<b>Level 2</b>	<b>Level 3</b>	<b>Level 4</b>	<b>Level 5</b>
<b>Level of Standardization</b>	No standard format	Partly used standard format	Complete standardization within the chain		
<b>Communication between Software and Standard</b>	No standardized communication	Standard format only used for exchange	Import and export of standard format		Direct S2S communication
<b>Implementation Taxonomy</b>	No taxonomy available	Taxonomy used in delivery only		Taxonomy used in delivery and processing	Taxonomy used in delivery, processing and reporting
<b>Data Validation and Checks</b>	Manual validations	Digital validation at the portal		Automatic validation at delivering parties	
<b>Consistency with Current Standards</b>	No standard format used	Standard format consistent within own chain		Standard format consistent with few other chains	Standard format consistent with all other chains
<b>Standardization of Process</b>	No fully standardized process	Standardized submit & accept process	Standardized prepare and submit & accept process	Standardized prepare, submit & accept and data processing process	Standardized prepare, submit & accept, data processing and reporting process

- What decisions must be made?
- Who should make these decisions?
- How are they made and monitored?

These three questions are embedded in the different dimensions as mentioned above. Question 1 and 2 are embedded into the dimension Who decides about what. The decisions cannot be divided between parties if the decisions are not clearly known beforehand. Therefore the first question is seen as a subquestion of the second question. The dimension Agreements among Organizations also entails a part of the decisions as the agreements among the organizations state who decides which party has the upper authority about what part of the data delivery chain. The reasoning part of question 3 is found in the dimension Decision-making Reason, which exactly encapsulates that part of the question. The before stated dimension Agreements among Organizations fills the monitoring part of the third question. The agreements allow other parties to monitor the decision-taking party as they agreed beforehand on these terms.

Revisiting the inter-governmental barriers from section 3.2.5 and 5.2.3, most dimensions in the governance category apply one of the barriers. The dimension Available Knowledge of Taxonomy and Software depicts the necessary knowledge that is needed to maintain the taxonomy, the software and the delivery chain itself. Staff is needed to maintain these aspects and the staff can be situated inhouse or at external parties [29]. As external parties create a dependency on this party, this is seen as the least mature option. An internal team with specialized knowledge of the/multiple full delivery chain creates the most secure option for inhouse maintenance and is therefore seen as the most mature option.

Authority about decision-making can be situated in different styles. The dimension Who decides about what depicts the centralization of the authority about the delivery chain. A standard within the full delivery chain is desired therefore a decentralized authority is seen as the least mature option. Since a decentralized authority per chain can still maintain a full standard within the full delivery chain, this is seen as more mature than different authorities deciding about different parts of the delivery chain. Parties can also influence each other in decision-making, which is one of the barriers as authorities usually want to preserve their control [29]. The different authorities can also influence the reasoning behind the decision-making. The dimension Decision-making Reason depicts the reasoning behind the decision-making by the authority figures. As benchmarking and trends give the most accurate prospect, data driven decision making is seen as the most mature option. An increased amount of data usage in the decision-making is seen as more mature.

The authority about decision-making can include other parties for advice or collaboration. The dimension Inclusion in Partnership depicts this aspect of the decision-making process. Usually, the requesting party is the one that has authority about the delivery chain and the data that must be delivered. As many parties want to retain control over their process, the requesting party is keen to decide about the delivery chain by itself [29]. However, as shown by the measures from the workshop, collaboration and integration of involved parties was number one priority of the participants. Therefore, more collaboration is seen as more mature and no collaboration is seen as least mature.

If parties are allowed to be involved in collaborations with the requesting party, the procedures and responsibilities need to be recorded. This is depicted in the dimension Agreements among Organizations. To prevent neglect and miscommunication, more strictly recorded agreements are seen as more mature than less strictly recorded agreements and responsibilities.

Table 5.5: Dimensions regarding the governance of the chain. The different options are given for each dimensions as well as their proposed level index.

<b>Governance Dimensions</b>					
<b>Dimension</b>	Level 1	Level 2	Level 3	Level 4	Level 5
<b>Available Knowledge of Taxonomy and Software</b>	External knowledge		Internal knowledge per agency	Internal knowledge at specialized team	
<b>Who decides about what</b>	Decentralized per part	Decentralized per chain		Centralized by specialized team	
<b>Decision-making Reason</b>	Decision-making based on intuition	Decision-making based on advices	Decision-making based on data and advices		Data driven decision-making
<b>Inclusion in Partnership</b>	Receiving party decides	Collaboration between receiving party, sending party and accountants		Collaboration between all involved parties	Collaboration with all involved parties and external parties
<b>Agreements among Organizations</b>	Agreements are known among parties	Agreements about procedures are made among parties		Responsibilities and procedures are strictly recorded	



### 5.3 Maturity Levels

All the different options available are incorporated into the matrices in previous section where the different options are filled in for five different maturity levels: level 1 to 5, with level 5 being the most mature level. The matrices are built with the options from the dimensions. The options are presented in the lowest level they represent. For example, exchange dimension Human Intervention has its options presented in levels 1 to 3 and 5. This spread means that the option for level 3, *Data import from a file (H2S)* is also presented for level 4. Level 5 has its own option presented with *Direct data forwarding (S2S)*. The levels are chosen based on the dependencies between the dimensions so that all options are consistent among each other and to create no interference.

The dependencies and interconnectivity among the dimensions also mean that it is very possible that an organization has a delivery chain which is level 4 for certain dimensions as well as level 1 for other dimensions. The maturity level is therefore calculated via the different dimensions in the maturity scan. The maturity scan presents the different dimensions and its options and calculates the average maturity level of all dimensions. This way, the maturity level of a delivery chain can be calculated and the different dimensions can indicate possible improvement steps in order to progress to the next maturity level on that aspect.

However, to progress to the next maturity level, certain key criteria are necessary to accomplish. These key criteria were developed from the held workshops and interviews. The different prioritized measures that were generated were extracted from the different options and their corresponding levels, since these options were viewed as the most important improvements for future progression. The full overview of all key criteria is found in figure 5.2.

Since all delivery chains are at least level 1, this level has only one key criteria: delivery is done on paper. The consequences of the paper delivery entail the different aspects of a 'level 1 delivery chain'. These consequences are the increased time per delivery and the following decreased frequency. Combined with the paper assurance on report level (financial statements) decreases the data quality in the delivery chain. The paper delivery also implies many error sensitive human interactions, which could also decrease the quality of the delivery chain as well as increase the probability of fraudulent behaviour.

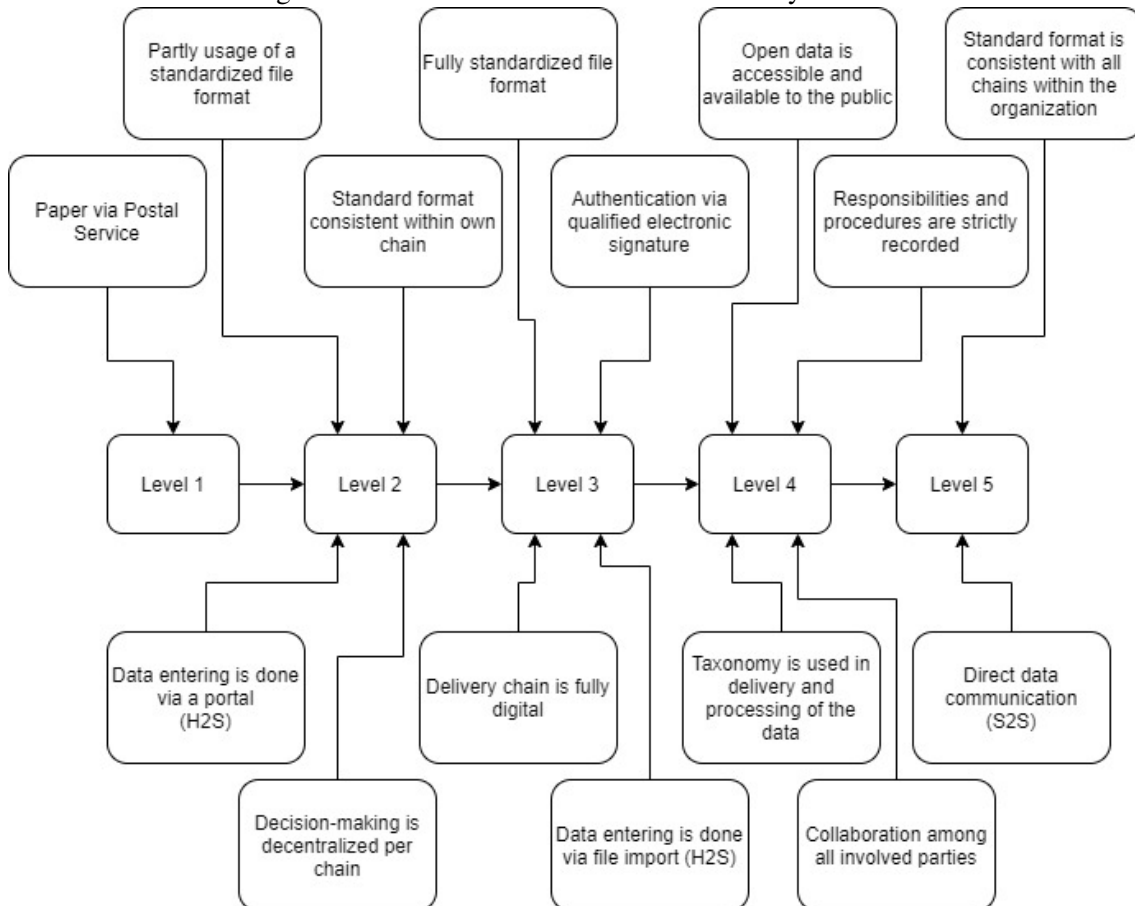
Level 2 decreases the usage of paper delivery by mixing in the partly usage of digital delivery. This implies the use of a partly standardized file format to deliver the data equally for all delivering agents. The delivered data is sent via postal service and digitally via an online portal. This portal allows the delivering agents to enter the data manually in order to deliver it via the standardized file format, which is consistent within the delivery chain. It is possible that certain pieces of data are double delivered via the paper delivery and digital delivery routes for the data quality or checks at the requesting agent. At least one of the routes requires the assurance to take place, most likely via scanned wet signature.

Exiting the paper delivery in level 3, where the delivery becomes fully digitalized. The complete digitalization implies certain steps to also become digitalized such as the assurance and the authentication process. It is necessary for the latter to become digitalized and use a form of qualified electronic signature to comply with the digital delivery chain. The delivery itself should now be possible to do via the portal without the manual entering. Therefore the option of importing the data to and exporting the data from the online portal should be possible. A file transfer contains significant less human interaction and error sensitivity and takes less time.

In level 4 the digital delivery chain is upgraded. Open data should be available, but also easily accessible for the ordinary man in order to be transparent and possibly increase economic and social effects. To accomplish the accessibility and availability, the taxonomy should be used in delivering of the data, but also in its processing. The required standardization allows the data to be published more easily and allows other parties to view the data more easily as well. To develop a taxonomy that is usable for both delivering and processing, all involved parties of the delivery chain should be included in the development. To create a stable collaboration among all these people, the responsibilities and agreements should be recorded strictly.

To progress to the final level, level 5, it becomes necessary that S2S communication is established. The direct communication decreases the weak points of the delivery chain as much as possible: nearly no human interaction and no re-entering of data. The S2S approach is only possible if the standard file format is used across all delivery chains by the organization. To ensure the data quality in this setup, the assurance is shifted towards system integrity assurance combining with more frequent deliveries.

Figure 5.2: Overview of all levels and their key criteria.



## 5.4 Limitations

Even with 24 different dimensions, the maturity model will not be perfectly complete. As every theoretical framework is an approximation of the reality, this maturity model has several limitations

or short-comings. The model should be taken as a growth and learning model, which should be improved via iterations in the future. Certain complexities were removed on purpose or for maintaining oversight. For this model nine limitations are listed, which may be altered in future iterations as well:

Starting with the complexities surrounding the data exchange medium. In this model only postal services or digital delivery were chosen as possible options. However, there are more (perhaps unpractical) options such as telephone or fax services. The digital delivery is also shortened with itself as the only option and not differentiating among different digital options such as e-mail, (paid) exchange applications as We-transfer or One-Drive, intra-net exchange services, etc. These extra options could increase the complexity of the maturity model.

Secondly, the return messages about decisions about faulty deliveries do not state differences among faulty deliveries. The model simplifies the deliveries from 'having this specific error' to 'having an error'. Different types of errors can be processed via different practices, which were combined in this model to a single practice. The model should therefore be read as 'the majority of errors are processed via ...' to assume deviations for special cases.

Thirdly, to increase data quality, the frequency of delivery can be increased, since a higher frequency allows for more continuous monitoring, resulting in more accurate data [30]. However, financial deviations may arise due to payments and product arrivals happening on different days and perhaps on different financial reports. The financial reports therefore should allow realistic margins in which the financial reports may vary. These margins can vary per frequency of delivery and are not given with the model. As the model is developed to be applicable in multiple situations, the margins may vary and should be established by a financial advisor or accountant.

Fourthly, the types of validations are simplified to just validation of data. The different ways to validate the data, such as three-way-match validation or confronting the data with other data, can have different levels of validity. This simplification is made for all certainty levels of data quality.

Fifthly, specific standard formats are left out of the model on purpose. It does not propose a certain standard file format like XBRL or CSV for different levels, but allows the policy makers to choose their own standard format based on the consistency with other existing chains within the organization. Each standard has its own advantages and disadvantages it is not possible to propose a single standard for all delivery chains.

Sixthly, the level of authentication is modelled to three options, whereas some options are left out or simplified. The model is limited to the digital authentication with the term qualified electronic signature, which is a summary of all forms of electronic authentication. Realistically, digital authentication can vary from (hard) randomized tokens to passcodes for services. Furthermore, biometric authentication such as finger print scanners and iris scanners are left out due to the complexity of the scanner itself.

Seventhly, the governance of a delivery chain can be complexer than described by this maturity model. The questions which effective IT governance should always answer, were answered [5, 56]. But due to the generality of the maturity model, the dimensions which were derived from these questions can be expanded. A limitation in the governance category is the way the decisions are executed, since execution of decisions is based on the agenda of the policy makers.

Eighthly, a general limitation is the way this model is developed. A single case study on the

data delivery chain to DUO was used to develop most of the model, with experts assisting in sharpening and expanding the dimensions. This does however create a problem that not all delivery chains are similar to the delivery chain to DUO. For example, the Tax Agency has a different delivery system with different requirements, such as no assurance and limited open data. In these cases, certain dimensions must be altered to fit the respective delivery chain. For the Tax Agency case, the assurance dimensions should be converted to assurance on the data at the Tax Agency instead of assurance by an accountant. It is found that the model can be applied best if the delivery chain has systems in all process step places: prepare, submit & accept, process and report.

The final limitation is a general limitation for the developed dimensions of the model: not every dimension has a clear best practice available, therefore certain options within the dimensions may need to be shifted or completely altered. To establish the best practice for each dimension in future research is necessary for improvement of the maturity model.



## 6. Demonstration of the Model

*Background, ©Engineered Fluids LinkedIn [57]*

Primary incentive to develop the maturity model was to assess and communicate the potential of SBR. This is demonstrated by assessing and proposing improvements to the existing data delivery chain to DUO. Educational boards have to send their financial statements and board report to DUO annually. The delivery chain had several challenges that emerged from past interviews of which the main points are the double delivery to DUO and the manual approval by accountants. The held workshops increased the list of challenges by adding the error sensitivity in de manual data entering on the portal, the lack of cooperation in the development of the delivery chain and the lack of digital assurance and authentication.

The developed maturity model and the corresponding maturity scan can aid in the improvement of these challenges on 24 different aspects which comprise the complete data delivery chain [58]. The descriptive function of the scan will describe the maturity level of the current delivery chain, whereas the model will implicitly allow the different aspects to be improved [59]. The model therefore has a implicit prescriptive purpose as it can aid in the improvement [8]. A single filled scan of a delivery chain can describe the chain, but may have been influenced by the person filling in the scan. Therefore, for more accurate scan results, the scan must be filled in by multiple members involved in the delivery chain which are not influenced by each other.

Four different organizations will be discussed in this chapter: section 6.1 will discuss the model usage for the delivery chain to DUO. Section 6.2 discusses the proposed progression steps for three other organizations: the KVK, the Belastingdienst and SBR Wonen. Before the progression steps can be implemented, certain possible dilemmas must be evaluated. These dilemmas are discussed in section 6.3. Finally, a disclaimer and the usage of the maturity scan is presented in order to use the scan for future assessments. The maturity scan is presented in section 6.4.

### 6.1 DUO

First, the maturity scan will be discussed in section 6.1.1, then the roadmap will be presented in section 6.1.2.

#### 6.1.1 Maturity Scan Discussion

Since the main incentive for the development were the challenges at the DUO delivery chain, this data delivery chain shall be described first. The maturity scan was presented to ten DUO employees involved in the delivery chain itself, processing of the delivered data or communications about the delivery chain. Many of these employees filled in the scan and were available to engage in a discussion about the results of the scan and therefore the outcome of the maturity level of DUO. The results of the scan before the discussion will be presented into two columns in table 6.1. The

dimensions and results in the left column are the dimensions, including the option, that were mainly agreed upon by the participants. The right column presents the dimensions and possible results that were mainly disagreed upon. Single different filled in results will not be marked as disagreed as the majority agreed upon a result. The single outlier may be due to incomplete knowledge or a mistaken scope of the delivery chain. For example, the processing of the data is outside the scope of the delivery chain, which was mistaken by some employees.

Table 6.1: Dimensions in the left column are the dimensions that the DUO employees agreed about before the maturity scan discussion. The dimensions in the right column are the dimensions the DUO disagreed about. Both main columns consist of two subcolumns with the dimension itself and one (in case of agreement) or more (in case of disagreement) options which were named.

<b>DUO Maturity Scan Results</b>			
<b>Agreed</b>		<b>Disagreed</b>	
Data Exchange Medium	Mixed delivery	Communication between Software and Standard	<ul style="list-style-type: none"> <li>- Standard format only used for exchange</li> <li>- Import and export of standard format</li> <li>- Direct S2S communication</li> </ul>
Human Intervention	Data entering on a portal	Availability Business Analytics	<ul style="list-style-type: none"> <li>- No analytics</li> <li>- Analytics within the delivery chain</li> <li>- Chain surpassing analytics</li> </ul>
Assurance	Paper assurance	Inclusion in Partnerships	<ul style="list-style-type: none"> <li>- Receiving party decides</li> <li>- Collaboration among all involved parties</li> </ul>
Frequency of Delivery	Annually with assurance	Available Knowledge of Taxonomy and Software	<ul style="list-style-type: none"> <li>- External knowledge</li> <li>- Internal knowledge at specialized team</li> </ul>

After the scan was filled in, the results were discussed during a small workshop with the participants that wanted to engage in the discussion. As expected, during the discussion everyone agreed about the beforehand agreed dimensions, hence the name. The disagreed dimensions were discussed in order. It was evident that the disagreements in the Communication between Software and Standard were due to the unclear scope of the delivery chain as both import/export and S2S are used partly in the processing of the data at DUO according to several participants.

The dimension about business analytics appeared to be cumbersome, as many participants assumed a different definition of business analytics. However, after understanding the scope of the delivery chain and the used definition, the participants agreed on the fact that there are almost no business analytics available operations happening within DUO. The same discussion occurred during the discussion around the partnerships of DUO. A different anticipated scope can alter the someone's view on the partnerships. The participants involved in processing the data do not engage in communication with the delivering parties or other involved parties, therefore they contributed the partnership to 'receiving party decides', as there is no collaboration. Participants involved in the communications, the accountants or the educational boards viewed this part as 'Collaboration with all involved parties'. After discussing the involved collaboration, it was clear that there was only

a collaboration with the educational boards and the accountant, as knowledge from, for example, software engineers, was not present. Therefore the option 'Collaboration between receiving parties, sending parties and accountants' was chosen to be applicable for DUO.

More discussion started with the mentioning of available knowledge within DUO. Due to the different views on the scope, the answers diverged significantly. The participants involved in the processing stated that the necessary knowledge is all inhouse at the IT department of DUO (stated as a specialized team). The participants involved in the delivery side, the portal and the taxonomy stated that much of the necessary knowledge is located at the external party Capgemini [60]. It appeared that if any problems arise with the taxonomy or the portal that one person of Capgemini is responsible for repairs and maintenance. The liability is here that if anything happens to that one person, the taxonomy and the portal are without someone who can maintain them. As one participant said during the discussion: *"This is a huge red flag in any form of risk management. Why is there no knowledge available at DUO?"* The same participant proposed the simple solution: internalize the knowledge at the IT department.

Another remark was made at the possible transition to a fully digital data delivery chain. The Caribic parts of the Netherlands also deliver their financial information to DUO. They however are unable to send it in a fully digital delivery chain due to communication problems in the country there. A valid point was raised that the government is for all its inhabitants and therefore should keep the postal delivery available for institutions that are unable to comply with the digital transition.

Summarizing the filled in scans, the accommodating discussions and the brought up solutions and extra points, DUO is put at maturity level 2 for qualified information exchange of the educational data delivery chain.

### 6.1.2 Roadmap for DUO

Following the results of the maturity scan and the key criteria necessary to progress as a delivery chain, the following progression steps are proposed for the policy makers that have the authority over the educational data delivery chain to DUO. The steps are presented with the memory of what the developed maturity model represents: the maturity model is a growth and learning model and develops perspective in learning about future progress of the delivery chain. It is not a perfect model and may be adapted or improved via iteration so it can more accurately assist in the progression of the delivery chain. Four progression steps are presented which are proposed to be taken in this order: the simpel progression step, the digital progression step, the system progression step and the automation progression step.

#### **Step 1: Simple Progression**

Few steps can be taken to progress without large effort. These progression steps can improve the data quality of the received data, but also reduce the administrative burdens and error sensitivity of the delivery chain. The main step here is to transform the portal to import data files instead of only allow manual entering of data. The transformation will require some new software, but can be done in two ways without disrupting the current flow. The first possibility is the adaptation of the portal to allow uploading XBRL files to the online portal. This is a simple adaptation to the portal, but has the consequence that educational boards and administrative offices must be able to generate the XBRL files themselves. An XBRL generating software addon to the largest financial software packets solves this issue. This addon must be developed in cooperation with the financial software packet manufacturers. The development costs some money and takes some effort. The second possibility is the added option to the portal which allows it to read either pdf or excel files in order to generate the XBRL files from it. This kind of recognizing software usually takes more

time and effort.

The development on the online portal also improves in terms of dimensions: the data is entered via file import instead of manual entering and the standardized file format XBRL is better incorporated into the chain if chosen for the first possibility in previous paragraph. To increase standardization, the first possibility is advised. As XBRL is already used within the Dutch government, to keep using the structured file format XBRL keeps consistency among the organizations. Therefore it is not advised to change the structured file format to something else than XBRL.

These simple progression steps are advised to start with as they require only software development, but no newly trained staff. As training of staff requires a lot of effort and time, the steps that can be taken without the training are advised at first.

### **Step 2: Digital Progression**

The next step in the progression is the transition of the main delivery route from paper to the digital route. Digitalizing the route reduces the time per delivery and also decreases the necessary manual labor as digital documents are more easily accessible than paper document. However, the digitalization also requires some initial development and development costs. In order to create a valuable digital delivery route, certain parts must be implemented first. These are the digital authentication systems and the digital assurance, which also needs the digital authentication system. Logius has developed a standard for digital authentication and digital assurance, which may be adapted for the implementation. Since more services will be digitalized, digital authentication systems become more necessary. Therefore it is advised to implement a qualified electronic signature as replacement for the currently used scanned wet signature.

Digital assurance may be viewed as a complete separate setup, that requires multiple developments, investments and improvements. However, this is not completely true. Digital assurance does require some investments, but these are mostly in the development of the digital authentication for the accountant and the other users. The accountant remains doing the same job of assuring that the collected data by the educational institutions is valid and not fraudulent. The difference is in the digitalization of the transfer of the data. By assuring the data in XBRL format, the data is kept structured for delivery and further processing and validating. The investments therefore lay out the full XBRL infrastructure to use for the delivery. Adding to the improvements of digitalization is the availability to easier business analytics due to the easier available digital data. Reports can easier be formed using the easier comparable data from past deliveries. This holds for both the delivering and the receiving party.

In order to keep the government easily available to everyone in the country, the paper route has to remain available for usage. This route is especially for institutions that are unable to comply with the already existing requirements of digital delivery, for example, the institutions in the Caribic part of the country. Completely digitalizing the delivery chain, including the digital authentication and assurance, progresses the delivery chain towards level 3.

### **Step 3: System Progression**

To progress further than level 3, several steps have to be taken starting with the process standardization. The internal validations via the taxonomy allow a more profound use of the XBRL files as they are able to intrinsically adhere to the business rules. The usage of the XBRL and the taxonomy can then be extended to processing of the data at DUO. As all elements within the taxonomy are defined single interpretable, the data should be perfectly structured from the delivering party to the accountant to the processing teams and the benchmarking teams.



The perfectly structured data and known elements from the taxonomy, combined with trusted source information, allows for a transition in the assurance of the data. It is proposed that a system integrity check is a more trustworthy procedure than accountant assurance. This way, the financial system is checked instead of the reports. In this assurance system, an IT auditor checks the integrity of the system annually or once every two years and the Inspectorate of Education can systematically check all data, whereas the accountant checks the data via the financial systems instead of via the financial reports. This does therefore not only change the level of supervision from report to system, but also the object of supervision.

For transitioning to the system integrity checks, both assurance systems need to work parallel. As the financial systems of the delivering parties will be checked, these systems can still produce the reports that are sent to the accountants. This way, the system integrity check will be monitored and validated parallel to the current assurance system to ensure maximum validity. Using the new system, the Inspectorate of Education can start their monitoring by sampling the digitalized systems. The digitalization, established and developed in the previous step, allows easier monitoring and therefore the transition to the new system and therefore increased data quality. This does require some substantial investments in the integrity check systems and software, but will pay off in by using fewer resources once implemented. Furthermore, the implementation does require collaboration with all involved parties, as all parties use the taxonomy and have a role in the new system integrity check system. The agreements and procedures among these partners in the collaboration should be recorded strictly, so that there are no liabilities or grey areas in responsibilities. The investment costs may be split among these partners.

The final benefits of this progression step is the applicability of the new systems to open data generation. Following the definition set by the Dutch government, open data should be made public in a structured file type. Hence all data is produced and processed in XBRL, this data can be published in XBRL format including the instance document to the corresponding taxonomy, which is also public. Completing all proposed substeps results in a maturity level 4.

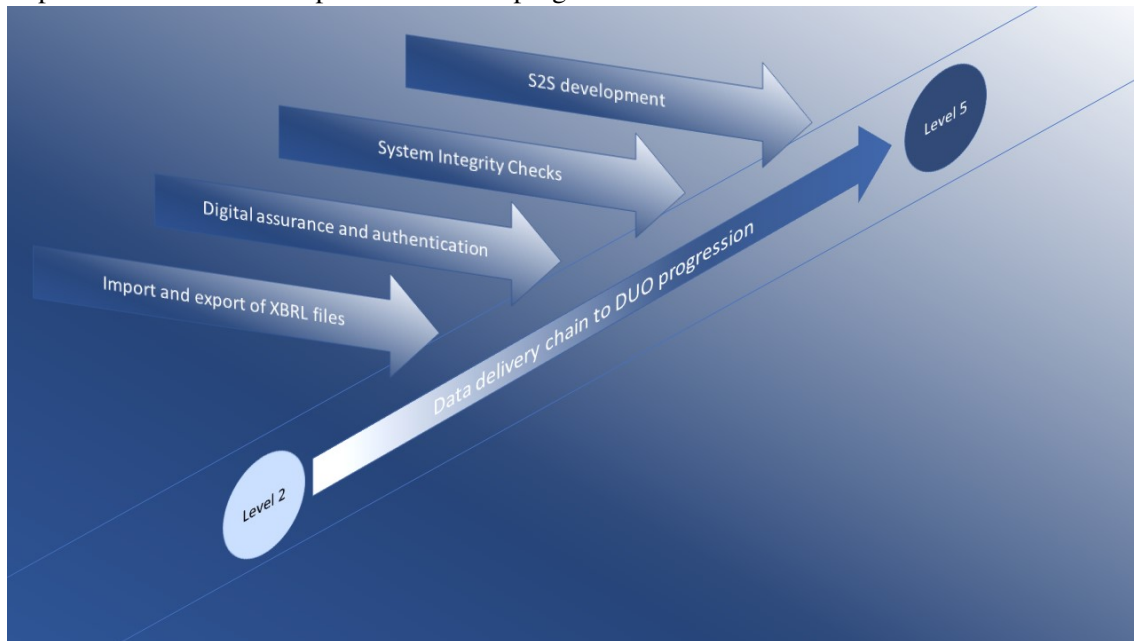
#### **Step 4: Automation Progression**

To progress to the final level in the develop maturity model, the weakest link has to be mostly removed from the delivery chain: the humans. Hence, S2S automation is proposed. S2S automation does require some investments, mostly in direct and secure communication among the software packets. The software packets that have to be connected are the financial software packet at the educational institutions, the processing software packet at DUO and the reporting software at DUO. This is also the downfall of the S2S approach, it only completely works if all parties involved also move along. The Inspectorate of Education also needs to be able to interact with the software as the assurance is still necessary. However, the level of supervision can now be improved as well. Data level assurance is proposed since automated checks are possible. The data is checked on transaction level and can automatically be send to DUO for (automated) processing, reporting and benchmarking. This, combined with the possibility for an increased frequency of delivery, increases the data quality significantly. Further investments are needed for systems that check all the transactions and specialized teams that maintain the automated systems, including the necessary training for staff. As other agencies within the government also move along the automated XBRL road, the complete consistency becomes more imminent. A result is the possibility for chain surpassing benchmarking and government wide business analytics.

Finalizing these steps brings the data delivery chain to level 5 on the maturity model, which is the maximum attainable level. However, as mentioned before: "The maturity model is a growth

and learning model and develops perspective in learning about future progress of the delivery chain. It is not a perfect model and may be adapted or improved via iteration so it can more accurately assist in the progression of the delivery chain." Therefore it can continue to be improved, which also applies to the delivery chain. Future insights may improve the delivery chain beyond the scope of this maturity model.

Figure 6.1: Progression line of the progression steps for the delivery chain at DUO. The most important investments are presented on the progression line.



## 6.2 Other Organizations

The maturity scan is also filled in by members of organizations other than DUO, which have a similar data delivery chain. The usage of the model at delivery chains of different organizations validate the generality of the developed maturity model.

### 6.2.1 KVK

The Chamber of Commerce (KVK) has a delivery chain that is similar to the delivery chain of DUO. The difference is in the delivering parties: instead of educational institutions, the KVK requires the financial data of regular companies. The delivery chain also has similar properties in terms of the maturity scan: mixed delivery with postal service, digital portal delivery and S2S software delivery. The specifications of the three delivery routes will be presented:

- Postal delivery route: annual delivery with paper assurance via a wet signature. Paper format is standardized and requires manual validation.
- Portal delivery route: annual delivery with digital assurance and a qualified electronic signature. Usage of standardized XBRL format with KVK taxonomy and validation at the online portal.
- S2S delivery route: annual delivery with digital assurance and a qualified electronic signature. Usage of standardized XBRL format with KVK taxonomy and automatic validation at the delivering party.

Furthermore, the delivered data is not reusable and therefore there are no analytics done. Communication about faulty deliveries is done via error codes and communication between software and standard is unknown as the business software that is used by companies is outside the view of the KVK. The delivery chain is maintained by a specialized team that cooperates with delivering parties and accountants with its decision-making based on advices.

The delivery chain has progressed further than the DUO chain, but still remains slightly in level 2, very close to level 3. To progress to level 3, the postal delivery route has to be reduced to a side issue, and the online portal improved with importing and exporting functions, similar to the 'Simple Progression' step from section 6.1.2, to reduce administrative burdens and error sensitivity. As the qualified electronic signature and digital assurance are already introduced in the delivery chain, the 'Digital Progression' step can be skipped. Since the board report is less important in the delivery chain to the KVK compared to the delivery chain to DUO, the digital assurance are simpler to implement. Due to the similarities in the delivery chains to DUO and the KVK, apart from the board report, the 'System Progression' step and the 'Automation Progression' step can be copied for the delivery chain to the KVK. A small deviation from the DUO progression steps is the already existing S2S delivery route. The S2S delivery route can be used as a base and validation for the investments done in order to improve to the next steps.

### 6.2.2 Belastingdienst

A different set of chains is maintained by the Tax Agency of the Dutch Government (Belastingdienst). Two chains were presented to the maturity scan: tax income for private individuals and for businesses. Both delivery chains will be presented and interpreted in the following sections. Both delivery chains have the specific characteristic that there is no accountant present in the process. Therefore the dimension assurance must be altered in order to fit this type of delivery chain. The assurance will be seen as the control of the data in the backoffice of the Tax Agency. Both chains are governed by a specialized team for each delivery chain.

#### Business Tax Income Chain

Businesses must report their profits and costs to the Tax Agency via the business tax income delivery chain. The business chain has similarities to the DUO delivery chain as educational institutions can be considered as businesses in certain instances. The business chain has two delivery routes:

- Portal delivery route (27%): annual delivery with qualified electronic authentication. Usage of standardized XBRL format at the online portal. Taxonomy is used for validation at the portal, but not in the backoffice. Data quality is checked via reports. The online portal allows data entering for now, import function is being developed.
- S2S delivery route (73%): annual delivery with qualified electronic authentication (PKIo). Usage of standardized XBRL format and validation at the receiving party. Taxonomy is used for validation, but not for processing. Data quality is checked via horizontal system checks.

Furthermore, business analytics are performed surpassing the chain, combined with reusable data within the whole organization. Data is presented to the Statistics Bureau (CBS) for open data, but does not publish the data themselves.

A main difference with the delivery chains to DUO or KVK is the amount of necessary items. Full financial statements are sent towards DUO or KVK, but the Tax Agency only requires a few numbers for the reports. Therefore different administrative burdens may arise if the delivery chain is altered significantly. Since the importing function of the portal is already in development, a large number of deliveries is done via S2S and authentication is done electronically, the business chain scores in maturity level 3, being more mature than their DUO and KVK counterparts. To improve the delivery chain, the backoffice needs upgrading to incorporate the taxonomy in processing of the

data. The supervision on the delivery systems also needs improvements as now only the S2S route is checked horizontally. A future improvement can incorporate the data level checks and the increase of the S2S percentage, but this will require a large investment in operating power, as a huge increase in data needs to be sent to be checked instead of the few numbers that business nowadays provide to the Tax Agency.

### Private Individual Tax Income Chain

Private individuals must report their tax income annually as well as businesses to the Tax Agency. This delivery chain has some different characteristics compared to the business chain, since private individuals (usually) do not have personal systems to keep their numbers updated. The private individual tax income delivery chain has three different routes:

- Postal delivery route (1%): annual delivery with wet signature authentication. Paper format is standardized and requires manual validation.
- Portal delivery route (76%): annual delivery with qualified electronic authentication (DigiD). Usage of standardized XBRL format at the online portal. Taxonomy is used for validation at the portal, but not in the backoffice. Data quality is checked via reports. The online portal allows data entering only.
- S2S delivery route (23%): annual delivery with qualified electronic authentication (PKIo). Usage of standardized XBRL format and validation at the receiving party. Taxonomy is used for validation, but not for processing. Data quality is checked via horizontal system checks.

Here, the S2S delivery route is used (almost solely<sup>1</sup>) by personal accountants (intermediaries) that submit the taxes for private individuals. Furthermore, equal to the business chain, business analytics are performed surpassing the chain, combined with reusable data within the whole organization. Data is presented to the CBS for open data, but does not publish the data themselves.

Due to the nature of the delivery chain, some options are not viable for private individuals without personal accountants. Importing the data to the online portal and S2S communications are unfeasible as the imported files or the sending systems do either not exist nor not be able to generate standardized importable files. Since a standardized delivery system is implemented already, using digital authentication, the private individual tax income delivery chain scores level 3 as well. Since the backoffice of this delivery chain has the same characteristics as the backoffice of the business chain, the backoffice improvements are equal. However, the system integrity checks and increased usage of S2S might be unfeasible since not all private individuals have a system present at home which can be checked on system integrity and perform S2S. Therefore the different progression steps may be evaluated if they are necessary for further progression or that the most improved options are already available by lower levels.

### 6.2.3 SBR Wonen

The final organization that filled in the maturity scan is SBR Wonen, which governs the housing corporation delivery chain. The housing corporations send two types of information over a single delivery chain. The difference is in the receiving side: the housing corporations must send their data to three organizations: Authority Housing Corporations (Aw), the Guarantee Fund for Social Housing (WSW) and the Ministry of the Interior and Kingdom Relations (BZK). SBR Wonen governs the delivery chain, but does not process the data. The information is split in two types: the accountability information (dVI), which contains the financial statements, board report, auditor's report and a public housing report, and the prospective information (dPI), which is a financial prognosis of the next five years. Both types of information have a separate delivery route:

<sup>1</sup>The consulted expert was unsure on this statement. It is however most likely that private individuals without the help of a personal accountant do not have the systems to use S2S for their tax income statements.

- dVI delivery route: annual delivery with paper assurance and a qualified electronic signature. Usage of standardized XBRL format with taxonomy and validation at the online portal and Digipoort. Portal accepts data entering only.
- dPI delivery route: annual delivery without assurance and a qualified electronic signature. Usage of standardized XBRL format with taxonomy and validation at the online portal and Digipoort. Portal accepts importing of files only. The generation of the XBRL files at the corporation side is unknown to SBR Wonen and most likely done with public market software. The dPI portal opened October 12th 2020 [61], therefore problems may arise during the early workings of the portal, which can impact the final delivery route.

Furthermore, the data is not reusable and therefore there are no automatic analytics done at SBR Wonen. There are, however, analytics at the receiving sides of the delivery chain.

The delivery chains by SBR Wonen are very similar in characteristics to the delivery chain to DUO, therefore most progression steps that were proposed for DUO are applicable here. Due to the paper assurance and the different portal systems, the SBR Wonen delivery chain scores maturity level 2. To progress to level 3, the dVI portal has to be improved with importing and exporting functions, similar to the dPI portal and the 'Simple Progression' step from section 6.1.2, to reduce administrative burdens and error sensitivity. As the qualified electronic signature is already introduced in the delivery chain, the 'Digital Progression' step only consists of the development of digital assurance. Due to the similarities in the delivery chains to DUO and SBR Wonen, the 'System Progression' step and the 'Automation Progression' step can be copied for the delivery chain by SBR Wonen.

### 6.3 Possible Dilemmas for Progression

The maturity model may indicate that progression is always better than the current system. However, several dilemmas may arise before the progression steps are taken completely. These dilemmas must be evaluated by the policy makers and other authoritative parties of a delivery chain before unlimited progression is developed and implemented. The dilemma of progression has always been around, is development always 100% better for the human race and the world we live in? As stated in *The Atlantic* by Caradonna (2014): *"What we learn from [...] scientific analyses is that the Industrial Revolution ushered in a veritable Age of Pollution, which has resulted in filthy cities, toxic industrial sites (and human bodies), contaminated soils, polluted and acidified oceans, and a "blanket" of air pollution that traps heat in the Earth's atmosphere, which then destabilizes climate systems and ultimately heats the overall surface temperature of the planet"* [62]. The negative sides of progression and development are often ignored. Therefore possible (unforeseen) negative sides may arise.

One of these possible negative side effect is the usage of digital systems without back-up systems. If systems are not significantly protected, they may be compromised by hackers or other malicious parties. The lack of security allows the other parties onto your system without much effort, much like the poor security of the POTUS twitter account [63]. Malicious parties that want to take down the delivery chain, can damage or compromise the financial data and privacy of the involved parties.

The same concern can be placed at the increasing development of quantum computers. It is thought that quantum computers will make 'regular' encrypting obsolete [64, 65]. New encryption techniques will be necessary if quantum computer become available to malicious parties. It might be necessary to start investing in 'quantum computer-proof cybersecurity' techniques, before the first quantum computer are operational. These investments however might be substantial compared to 'regular' security investments due to the unknown nature of the possibilities that the quantum computer may allow. It is expected that the first quantum computers become operational in about

ten years [66, 67].

Further dilemmas may arise when decision-making is based purely on data. Data-driven decision-making can enable tunnel vision and create scenarios where the environment surrounding the data becomes irrelevant. An analogy can be made for an autocue: the autocue is followed to the letter, but the environment or the meaning of the message becomes irrelevant. The anchorman will read the autocue with little regard for the message.<sup>2</sup> Purely data-driven decision-making can result in misinformation if this information is faked or altered, without using advices from the environment surrounding the data.

The introduction of advanced AI can also impact the control of the policy makers in later stadiums. Advanced AI can assist in the progression of communication and processing of the data, but is not perfect or can create false reports. The use of AI should then be assisted by trained staff that can recognize false reports. Further trained staff is needed to maintain the AI, which can lead to more investments. The investments in AI can also be substantial if the advancedness of the AI is necessary to do certain tasks to a high degree of quality. A too advanced AI however should likely be avoided as was suggested by James Cameron in his movie *The Terminator*, where the AI takes over the world and eradicates the human race [69].

#### 6.4 Usage of the Scan

The maturity scan was used to assess the maturity level of several SBR data delivery chains. Since the maturity scan is an extension of the maturity model and a model is an approximation of the reality, which implies that the model has certain limitations, the maturity scan also has limitations. A much complex set of dimensions can be developed, which can increase the accuracy, but will decrease the readability of the model. This trade-off is the base for many limitations within the dimensions, as not all in reality available options are presented for each dimension. Options as, among others, fax service as exchange medium, biometric scanners as authentication method or specific error systems in the communication about faulty data deliveries are left out due to complexity of the model and the development of the maturity model from a single case study. The order of the presented options may be altered as well, as some dimensions do not have a clear known best practice. For generality, no certain standard file format is proposed, since many forms of standard file format can be used to exchange financial data digitally. This generality may develop some ambiguities, since data delivery chains are usually not completely similar. Furthermore, no change mechanisms are presented in the model for transitions from situation A to situation B. The complexities of these transitions regarding organizational actions and agreements are outside the scope of this maturity model. The maturity model presents the situations of the proposed higher maturity levels (situation B), but does not present the transition steps in between (situation A→B).

However, against all limitations, the usage of the maturity scan may give an understanding of the aspects of the current data delivery chain. The identification of these aspects can then be used to identify future progression steps in order to improve the data delivery chain on the set of presented dimensions. The model can therefore aid in developing a view for the future situation (situation B) for the data delivery chain to strive for. The maturity scan can be accessed online at [digicampus.tech](http://digicampus.tech). Digicampus and/or its authors cannot be held responsible for liabilities that occur due to or in the usage of the maturity model or the maturity scan.

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<sup>2</sup>A news broadcast was hacked and streamed on YouTube. The anchorman and woman followed the message to the letter while only realising later on that it was significantly altered [68].



## 7. Concluding Remarks

*Title Screen Droplet, ©Cutting Edge Fluids, Inc. [70]*

To conclude this study, the conclusion will be presented in section 7.1. A reflection on the study from the authors perspective will be given in section 7.2. Important limiting factors of the maturity model and the study in general will be presented in section 7.3. Finally, topics for future research are presented in section 7.4.

### 7.1 Conclusion

Via a case study done on the educational data delivery chain to DUO, a maturity model was developed. It was started by collecting past workshop and interview results. These results concluded that there were some challenges within the current delivery chain that created extra burden or increased error sensitivity. The increased administrative burden resulted mainly from the double delivery route and the manual data entering to the online portal. The error sensitivity is also a direct result from the manual data entry. However, it was thought that these were not the only challenges. How is it possible to improve the delivery chain structurally? A maturity model would be structural model to create a base en guidelines on which the delivery chain can be improved. It can also improve the knowledge about SBR by communicating and assessing its potential. This resulted into the research question: **What are the components of a maturity model for qualified information exchange?**. The research question was divided into six separate subquestions:

1. What is the current SBR data delivery chain to DUO?
2. What are the current perceived challenges/barriers in the SBR data delivery chain?
3. What are potential measures to these challenges/barriers?
4. What dimensions are needed for a maturity model?
5. Which dimensions have a higher priority?
6. How do organizations score on the maturity model?

The subquestions were answered in different steps: the current data delivery chain and its challenges were analysed with the help of a BPMN model and several workshops and interviews (1). The workshops were held with parties involved in the delivery chain: policy makers from OCW who decide about the chain, employees from DUO who maintain the chain and process the incoming data, employees from Logius who govern the chain and educational council members who represent the educational institutions which are required to deliver the data. The interviews were held with board members of educational institutions in order to validate and broaden the challenges mentioned by the educational council members. The interviews indeed validated the challenges by the council members. The listed challenges in the current data delivery system are, among others: the reduced collaboration between involved parties, the paper assurance and the communication between software and the used standard format XBRL (2). During the workshops and interviews, measures were developed in order to combat the challenges. Measures included workshops and

involving parties in the development of the delivery chain, the implementation of digital assurance and authentication, and improving the online portal to allow file imports before progressing to S2S communication. The measures were voted for as well to create priority among the measures (3).

As the developed measures were extensive, the measures were used in developing a list of areas for the maturity model. This list underwent many iterations which expanded the list significantly to the final 24 dimension, categorized in five categories. The different categories are based on the areas that the dimensions represent and may be improved in future iterations. The categories are: the exchange dimensions, the data dimensions, the data quality dimensions, the standardization dimensions and the governance dimensions (4). Each dimension contains different options which are divided over the different proposed maturity levels. These levels represent the maturity stage which a delivery chain is and also assist in improving the delivery chain by striving for a more mature option within the dimension. By interviewing experts and using literature on the areas of SBR, data quality, QIE and XBRL, the model was evaluated, expanded and validated with key criteria and conditions. The key criteria are dependent per maturity level, but mostly consist of the dimensions Level of Standardization, Human Intervention, Certainty Identity of Supplier and Intermediary and Data Exchange Medium. These key criteria are the base for each level and are developed using the priority scale created during the workshops for the maturity levels (5).

A maturity scan was developed as well in order to score delivery chains on the maturity model. The scan allows participants to choose the appropriate option for their delivery chain without knowing which option refers to what maturity level. The score will then indicate which maturity level the chain is and the model can then prescribe which steps can be taken in order to progress to the next maturity level. The other organizations that filled in the maturity scan also validate the generality of the model and its usage in generic delivery chains. However, it was shown in section 6.2.2 that a delivery chain has some requirements in order for the model to be fully implemented. The delivery chain should have systems in place where the data is prepared, where the data is submitted & accepted and where the data is processed and reported following the dimension Standardization of Process. The organizations scored the following scores on the maturity scan:

Table 7.1: Scoring of five SBR data delivery chains.

<b>DUO:</b>	Level 2
<b>KVK:</b>	Level 2
<b>SBR Wonen:</b>	Level 2
<b>Tax Agency, private individuals:</b>	Level 3
<b>Tax Agency, businesses:</b>	Level 3

Therefore the subquestions are answered: The current SBR data delivery chain to DUO includes a double mixed delivery using manual entering of data and postal services. The taxonomy is implemented in delivering, but uses XBRL only as flat data without its intrinsic properties (1). The current perceived challenges include the lack of digital assurance and authentication, the reduced collaboration among parties and the double delivery via both postal service and manual entering on the online portal (2). Developed measures to these challenges include improve cooperation among parties including software suppliers and Logius, developing a protocol for digital authentication and assurance and reducing the administrative burdens by developing a method to import and export XBRL files to the online portal directly without manual entering of the data (3). Twenty-four dimensions were developed for the maturity model, based in five categories: exchange dimensions, data dimensions, data quality dimensions, standardization dimensions and governance dimensions (4). Some dimensions received a higher priority due to the developed key criteria.



These dimensions are the Level of Standardization, Human Intervention, Certainty Identity of Supplier and Intermediary and Data Exchange Medium (5). Five organizations were assessed via the maturity scan, the results are presented in table 7.1 (6). The subquestions finally answer the main research question. The components of the maturity model are the twenty-four dimensions, including the necessary conditions and the key criteria for the maturity levels, and the maturity scan, which is also seen as a component of the model because it is necessary for assessing SBR data delivery chains.

## 7.2 Reflection

In the beginning, it was very hard to start in a world of many different aspects, when a background in physics is present. The many iterations and improvements of the maturity model over the internship period were a new sight for someone that is used to the 'mono-disciplinary' world of physics, where the rules and frameworks are set by mathematical rules. Even though the many different areas of physics are linked to each other, many areas are segregated into different fields of physics. Then there is the 'multi-disciplinary' world of social sciences, where everyone has a different look on everything and everyone values a different part of the work (at least, that is how it felt sometimes). After iteration X, when thought that the set of dimensions finally encompassed all aspects of qualified information exchange, someone brought up another aspect, which was different from the some of the previous dimensions and had connections or dependencies to multiple other dimensions.

These aspects of social sciences research make it hard to enter for someone not within the field. Good guidance helped me in entering the field step by step and introducing new aspects nearly every meeting. The guidance was needed as I had no idea where to start from the start looking. After redirecting the direction of the internship twice due to bureaucratic interventions, the idea for a maturity model and accompanying maturity scan was proposed. The idea of a maturity model was quite the finding, adding a completely new (large) expansion to the process of improving the DUO delivery chain. It was presented as a very hard assignment, which it was and this made me hesitant, but curious for the idea. However, the initially very unclear scope of the maturity model, combined with many unknown and hard concepts (such as governance), created the previous mentioned different looks on everything, et cetera. Collaborating with many participants of Digicampus, DUO, Logius and prof. Verkruijsse allowed me to improve the scope of the maturity model and focus on the dependencies between the dimensions.

Looking back, I should have interviewed more different people and their views on a delivery chain and its scope. The different views allow for a broader image and also provides many different takes on the subject, which may reveal new insights. The insights have been granted, but some later than desired in retrospect. It would have sped up some development parts if the different insights would reveal the scope earlier on. However, that is also in combination with the fact that during that time I was unaware of the many different views on the subject.

Of course, the coronavirus also impacted the internship and thesis significantly. Home working instead of the (if I may say so, beautiful) view of the DUO office on the 17th floor decreased motivation. The regular meetings with my supervisors and other meetings with SBR Vernieuwing, SBR Experimenten and the DUO meetings also provided some sort of structure to the mostly indifferent days of walking from my bed to my desk and back. Henceforth, it was really helpful to have this structure to develop the maturity model and write a thesis in these turbulent times.

This research is considered part of the MOT programme by being a constructive model which can structurally improve services by developing and implementing new technologies to the data

delivery chain to DUO. After implementation of the new technologies, it can significantly improve corporate productivity and customer satisfaction by reducing the administrative burden of the educational institutions (customers in this context) and the processing time and operating costs of DUO (corporate in this context). The methods of questionnaire, workshops and interviews were used in this study, which are part of the MOT curriculum. The corporate perspective is maintained via the case study and the major progression steps developed based on the delivery chain to DUO.

A water theme was chosen for the lay-out, since water flows to the place of least resistance or energy. This can be translated to the made progression to the place of least administrative burden, connecting the management of technology master to my former physics education, where I studied supercritical fluid flow [71].

### 7.3 Limiting Factors

The maturity model is limited in its capacity. These limitations are a result of the approximation of reality and the development from a single case study. There are dimensions that were simplified by combining certain options to a singular option or leaving certain options out completely. The general criticisms on maturity models from section 3.3 will be evaluated and combined with the obtained limitations mentioned in section 5.4. This section will follow the list from section 3.3 in the same order. The limitations from section 5.4 will be inserted in this order if applicable or expand the list in the end.

The developed maturity model retains its generality. This was validated by testing delivery chains to other government agencies. However, since a limited amount of delivery chains were tested, this does not mean that the developed model is universally applicable. To keep the generality, the usage of certain dimensions were kept ambiguous, such as assurance and reusability of data. For example, these dimensions are applicable to a lesser extent to personal income tax delivery chains. Furthermore, the governance dimensions may be seen as vague and can be expanded more in order to develop a more accurate model.

Applying literature and implications from SBR principles, this model report the applications of technologies, but also argues why these technologies are necessary. An example is the implementation of the system integrity checks. The system is necessary to uphold or even increase the data quality after other applications are made (digital assurance), which create a more vulnerable system to fraudulent behaviour or other malicious actions.

Some descriptiveness and aspirational parts of a maturity model are left in the developed model. Due to the single case study in order to develop the maturity model, a certain level became the base for what is the current delivery chain to DUO in case of ambiguity or uncertain dependences to index the maturity levels. Some aspirational parts also exist due to the unavailability of the best practice in these dimensions. This best practice vacuum breeds aspirational ideas for high maturity levels for these dimensions. Furthermore, politics or the impact of politics were not taken into account, which may alter the possible high maturity levels even more.

As shown in section 5.4, many dimensions are limited in their options. These options sometimes combined due to complexity or removed completely. Important upcoming technologies (cloud computing, quantum computing, etc.) may advance dimensions in future iterations and alter some options and their respective maturity levels. However, this model does include improved AI and discusses the dilemmas surrounding quantum computing.

Some change mechanisms are presented to prevent too sharp or impossible transitions to newer technologies or services. Certain changes can be applied more easily as the delivery frequency is annually, which provides a large time interval for implementation before the new delivery is imminent. Other transitions may take more development and implementation costs, such as the system integrity check transition. A sample system by the Inspectorate and accountants was proposed for the transition.

The case study on the delivery chain to DUO, the validation via the delivery chains by KVK, SBR Wonen and the tax agency, the workshop and interviews create a base as methodological research for the developed maturity model. The case study and workshops are supported by literature, which makes the model a theoretically and empirically supported. Particularly the literature on SBR was an enormous base for the theoretical support.

The developed model currently supports 24 dimensions. However, this amount can most likely be increased significantly by organizing the complexities of some dimensions, especially the governance dimensions. More dimensions may create a more accurate model. However, this accurateness may be a trade-off to practicality and readability. Because of the possible increasing the amount of governance dimensions, certain socio-technical aspects are left out. This also applies to political dimensions and the impact of political support. Finally, the development of this model focused on the technical challenges in the data delivery chain, when there are more types of challenges that can be taken in consideration.

The scoring of the maturity level is a documented process. The maturity scan has concrete scores on all options of all dimensions and a concrete formula to calculate the score. The maturity level is based on this score if the key criteria are met. For example, if nearly all dimensions score are scored maximally, but the data entering is still via manual data entering on an online portal, the maturity level is kept at level 2, even though the calculated score may indicate level 4 or higher.

Apart of the list from section 3.3, a few other limitations were proposed. These limitations were mostly regarding options within existing dimensions, such as the left out biometric authentication due to complexity in the Certainty Identity of Supplier and Intermediary dimension. This also applies to extra implications that are necessary due to certain options. In the option Monthly with Assurance in dimension Frequency of Delivery, it can create monthly discrepancies in financial reporting due to differences in payment and arrival of goods. Therefore a margin is necessary within the differences are acceptable. This study does not provide such necessary margins. Finally, any standard format is left out of the model. It is believed that any structured file format may be used to equal success. However, consistency within the organization is proposed to combine results in processing or combine (parts of) delivery chains.

## 7.4 Future Research

Based on the limiting factors from section 7.3, several topics for future research are proposed. Starting with the availability of the best practice in certain dimensions. These dimensions have no certain best practice, which if found, may alter the dimension or its options. This is expanded by inclusion of the removed or simplified options. Certain options were combined or removed due to the increased complexity. To use these options independently might give more insight in these dimensions. An example is the way of authentication where biometric authentication was removed due to complexity and different types of digital authentication simplified to qualified electronic signature. A study focused on a single dimension or a set of dependent dimensions is recommended for more accurateness and indepth knowledge.

In line with the first proposed future research, the second proposed topic is the inclusion of important upcoming technologies, such as cloud computing, quantum computing, etc. These types of new technologies may alter the options list or expand the options list beyond the current options and maturity levels.

Thirdly, a more extensive verification study on the generality of the maturity model is proposed. In this study, different types of SBR data delivery chains can be evaluated for a more generic and accurate maturity model. Different aspects of different data delivery chains may result in different characteristics of the model in terms of specific dimensions or impossible options for certain new data delivery chains.

Finally, the maturity model only sets the new situations, but does not propose a change mechanism to reach the new situation. The transition may require many in between steps with large organizational challenges. The communication, finances and agreements surrounding these aspects need to be established for the transition to a new more mature level. Scenario planning or business games may develop opportunities for these transitions and can also aid in the decision-making for the transition itself.

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# A. Overview of Challenges and Measures

Organized lists of all challenges in section A.1 and measures in section A.2.

## A.1 Workshop Challenges

As discussed in section 4.3.2, an organized list of all the obtained challenges will be listed here for both workshops. The original boards are also presented in figures A.1 and A.2. The challenges will be hierarchically listed in Category of challenge: organizational, technical, legal or unknown. Within these categories, there will be a difference made in the inputting organization for workshop 1. An example list will be:

- Category
  - Organization
    - \* Challenge 1
    - \* Challenge 2
    - \* Etc.

The full list of the first workshop is as followed:

- Organizational Challenges
  - OCW
    - \* Financial Statements must be usable for other stakeholders as well
    - \* Digital assurance
    - \* Definitions in the taxonomy must be flexible in order to accommodate for future changes
  - DUO
    - \* Delivery of data on institution level instead of board level
    - \* Cooperation with other XBRL users
    - \* Usage of System2System
    - \* Single delivery, using the taxonomy of the Chamber of Commerce
  - Primary Education Council
    - \* Direct availability/transfer of XBRL data for other parties as soon as the institution has uploaded them
    - \* Digital delivery only, no double delivery
  - Remaining
    - \* The importance of the board report in combination with the financial statements
    - \* Development of the digital assurance
    - \* Incentives to create traction with software suppliers
    - \* Increasing the flexibility of the taxonomy
- Technical Challenges
  - DUO
    - \* Developing System2System

- \* Direct transfer of data from the board of directors to DUO
- \* Digital assurance
- \* Increased flexibility of the taxonomy
- \* Possibilities to increase the ease of communications between XBRL and report / control software
- \* Taxonomy is not up to standards, which creates problems in other report software/-tools
- Primary Education Council
  - \* Optimal reuse of existing information (for example, salary systems, employee and student registers)
- Remaining Challenges
  - \* Lack of flexibility of the taxonomy
  - \* Digital assurance
  - \* Digital board report and signature
- Legal Challenges
  - OCW
    - \* Privacy proof system
  - DUO
    - \* Digital assurance
    - \* Usage of social security number
  - Remaining
    - \* Legal basis for requirements for SBR-XBRL
    - \* Responsibility financial statements category in the taxonomy
- Unknown
  - OCW
    - \* No insight in delivery process
    - \* Financial statements also usable for other instances
    - \* How can we use the financial and retrospective numbers to create insight in the effectiveness of the policy?
    - \* How can we use the available data to gain insight in solutions in for example the teacher shortage?
    - \* How can we use the available data to choose the most excellent school of the Netherlands?
  - DUO
    - \* Direct transfer of data from the board of directors to DUO
  - Primary Education Council
    - \* Digital assurance
    - \* Delivery of non-financial data via XBRL, including a formal XBRL validation
  - Remaining
    - \* Create order in unstructured documents
    - \* Create cost effectiveness of existing solutions (for example, differences in tariff for small periodic flow of messages)
    - \* Increased stability in data requests
    - \* Development of the need of information for reduction of data (data to information transition)
    - \* Standardization of used definitions (demands heavy investment and chain development)

The full list of the second workshop is as followed:

- Organizational Challenges

- Most primary educational institutions let administration offices compose their financial statements, therefore unable to accompany all changes as there are oblivious to many changes
- A digital portal or platform will give direct feedback on missing or forgotten elements in the financial statements
- Digital assurance
- Technical Challenges
  - Financial statements are put in in XBRL manually
  - Communication between financial software and digital portal
  - All financial files need a wet signature. how to change that?
- Legal Challenges
  - Must be send both on paper and digitally
  - Possibility to give digital delivery the same status as paper delivery?
  - Responsibility of software communication given to the software supplier
- Unknown
  - Responsibility of input of financial statement data
  - Completely digital, just like the tax statements
  - Clear professional responsibility becomes more and more necessary
  - Increased error sensitivity of paper delivery
  - Political or board support

## A.2 Workshop Measures

As discussed in section 4.3.3, an organized list of all the obtained measures will be listed here for both workshops. The original boards are also presented in figures A.3 and A.4. The measures will be hierarchically listed in Category of challenge: process, data, IT, legal or unknown. For workshop 1, there will be a difference made within each category in the inputting organization. Workshop 1 also ranked every measure via a voting system during the workshops. Therefore a ranking number is present behind every measure. The ranking is in decreased order, meaning (1) is ranked highest and (4) is ranked lowest. An example list will be:

- Category
  - Organization
    - \* Measure 1 (1)
    - \* Measure 2 (4)
    - \* Etc.

The full list for the first workshop is as followed:

- Process Measures
  - OCW
    - \* Procedural incorporation of changing flexible information needs (for example, moments of change every six months) (4)
  - Logius
    - \* Involvement of receiving and sending parties in the development of the taxonomy (3)
  - DUO
    - \* Cooperation with partners like the Chamber of Commerce (4)
    - \* Creation of digital assurance with accountants (3)
  - Primary Education Council
    - \* Creation of process for digital assurance (3)
    - \* Involvement of relevant stakeholders in development XBRL (2)
- Data Measures

Figure A.1: Dutch overview of the obtained challenges in the program Miro during the first workshop. The organisation colours are given on the left side of the board. The colours represent the organization of the participant that set down the challenge.

1. Vul hier de uitdagingen in die u momenteel ervaart in het aanleverproces.
2. Vul deze punten in op sticky's met de kleur van uw organisatie
3. Punt al ingevuld? Nog eens erbij ter benadrukking.
4. Ook de 'dit kunnen ze niet oplossen'-punten willen we graag horen!

### Bord 1: Uitdagingen

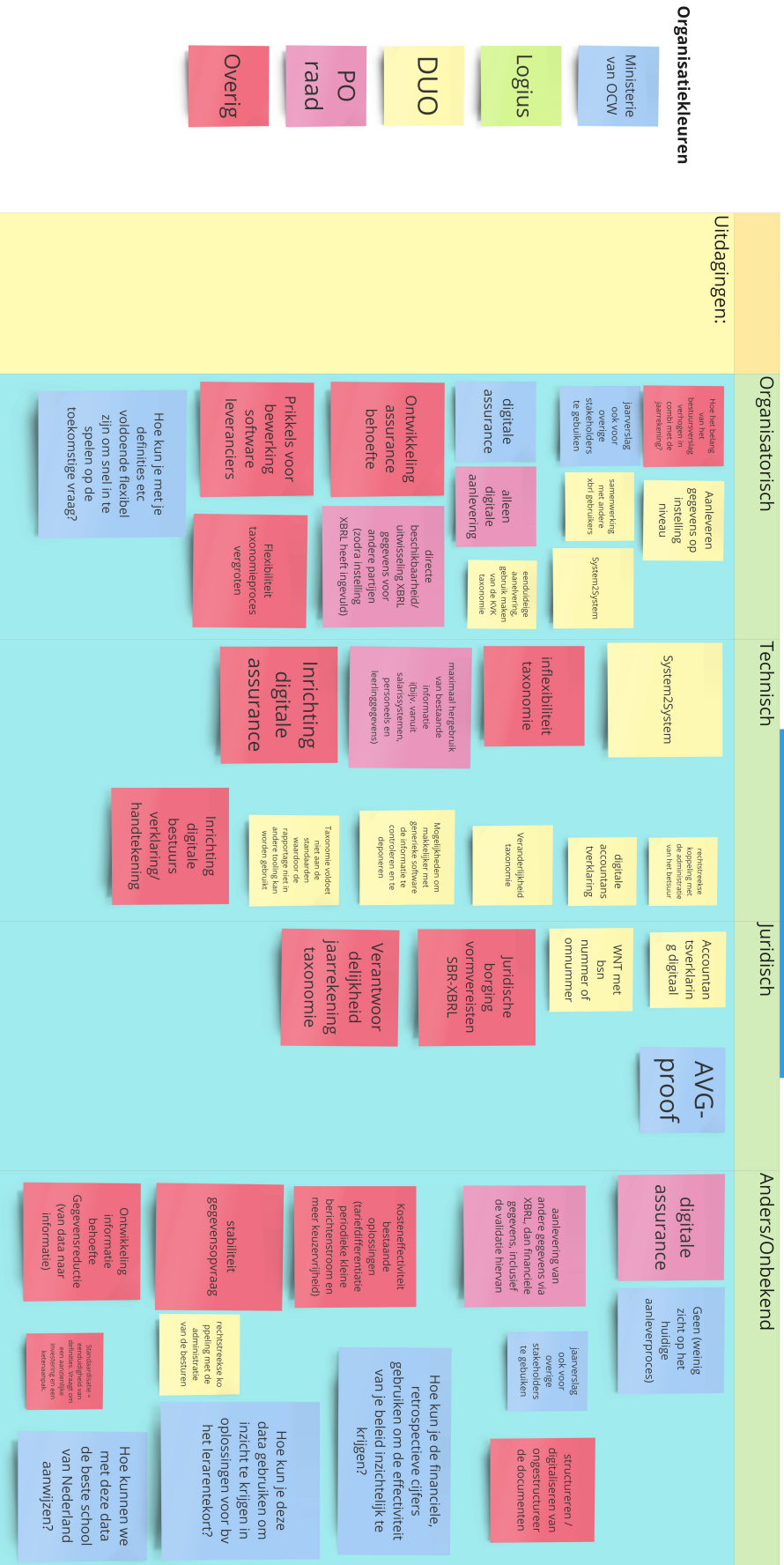


Figure A.2: Dutch overview of the obtained challenges in the program Miro during the second workshop. The organisation colours set differently at the second workshop: the workshop was more an open conversation, where the participating council members brought up challenges as well as the host whom noted points from the conversation.

1. Vul hier de uitdagingen in die u momenteel ervaart in het aanleverproces.
2. Vul deze punten in op sticky's met de kleur van uw organisatie
3. Punt al ingevuld? Nog eens erbij ter benadrukkung.
4. Ook de 'dit kunnen ze niet oplossen'-punten willen we graag horen!



- OCW
  - \* Cooperation about creation of datasets (2)
  - \* Increasing the usage of XBRL for non-financial aspects (could require an addition to the taxonomy) (2)
- Logius
  - \* Elaborate on the usage of data after the delivery (2)
- DUO
  - \* Straightening of data (much data is on institution level, whereas XBRL is on board level) (2)
- Measures for the IT
  - DUO
    - \* Cooperation with software suppliers and consultants for integration and reporting possibilities (1)
    - \* Creating different kinds of software starterkits for institutions (possibly for payment) (4)
  - Primary Education Council
    - \* Stimulate cooperation between processing units for optimal reusage of information (3)
    - \* Creation of protocol for direct XBRL data transfer with external parties (2)
- Legal Measures
  - Logius
    - \* Formalising the digital assurance (4)
  - DUO
    - \* Making delivery with social security number mandatory (4)
- Unknown Measures
  - OCW
    - \* Planning of visits to processing units for insight on the current delivery process (4)
  - Primary Education Council
    - \* Development of validation protocols for data that is not checked by the accountant (for example, employee information) (4)

The full list of the second workshop is as followed:

- Process Measures
  - Single working posture for all public agencies
  - Single delivery chain for educational finances
  - Decreased administrative burdens by direct throughput (added result is decreased error sensitivity)
- Measures for the IT
  - Automation is not a question, but a necessity
- Legal Measures
  - Make digital throughput mandatory by law
  - Make digital throughput mandatory for future tenders
  - Create quantitative (numerical) insight in order to increase political / board support
- Unknown
  - It's not of this time anymore



Figure A.3: Dutch overview of the obtained measures in the program Miro in the first workshop. The organisation colours are given on the left side of figure A.1. The colours represent the organization of the participant that set down the measure.

1. Vul hier de maatregelen in voor de bedachte uitdagingen.
2. Betreffende uitdaging in enkele woorden bij de maatregel zetten
3. Maatregelen op andermans uitdagingen zijn meer dan welkom.
4. Momenteel 'onuitvoerbare' maatregelen zijn ook welkom!



Figure A.4: Dutch overview of the obtained measures in the program Miro in the second workshop. The organisation colours set differently at the second workshop: the workshop was more an open conversation, where the participating council members brought up measures as well as the host whom noted points from the conversation. The colours of the council members and the host are given on the left side of figure A.2.



## B. Checklist HREC TU Delft

A checklist by the Human Resource Ethics Committee of the Delft University of Technology is added. The full procedure can be found online on the TU Delft website via <https://www.tudelft.nl/over-tu-delft/strategie/integriteitsbeleid/human-research-ethics/application/> [15]. The following pages contain the document that was necessary for the use of humans in research. This applied to the held workshops and interviews with the participants. Since this research was considered minimal risk, the form was never send to the human research ethics committee. However, in order to show that it was considered and an application was formed, it is included in the appendix.

**Delft University of Technology**  
**ETHICS REVIEW CHECKLIST FOR HUMAN RESEARCH**  
(Version 18.06.2020)

*This checklist should be completed for every research study that involves human participants and should be submitted before potential participants are approached to take part in your research study. This also applies for students doing their Master-thesis.*

In this checklist we will ask for additional information if need be. Please attach this as an Annex to the application.

The data steward of your faculty can help you with any issues related to the protection of personal data. Please note that research related to medical questions/health may require special attention. See also the website of the [CCMO](#).

*Please upload the documents (go to [this page](#) for instructions).*

*Thank you and please check our [website](#) for guidelines, forms, best practices, meeting dates of the HREC, etc.*

## I. Basic Data

<b>Project title:</b>	<b>Challenges in the Data Delivery Chain Maturity Model</b>
<b>Name(s) of researcher(s):</b>	<b>Leon de Vries</b>
<b>Research period (planning)</b>	<b>09-03-2020 to 07-12-20</b>
<b>E-mail contact person</b>	<b>Leondv96@gmail.com</b>
<b>Faculty/Dept.</b>	<b>TBM</b>
<b>Position researcher(s):<sup>1</sup></b>	<b>Student</b>
<b>Name of supervisor (if applicable):</b>	<b>Marijn Janssen</b>
<b>Role of supervisor (if applicable):</b>	<b>Chair supervising committee</b>

## II. A) Summary Research

(Please very briefly (100-200 words) summarise your research, stating the question for the research, who will participate, the number of participants to be tested and the methods/devices to be used. Please avoid jargon and abbreviations).

A maturity model for digitalizing the data delivery chain for financial data will be developed using input from participants in workshops. The participants will input their ideas about challenges and opportunities in the current delivery chain and originate from DUO employees, ministry of OCW employees and educational council members. The input will be validated with few interviews with members of actual boards of directors of educational institutions

The developed maturity model will then be evaluated and validated during a new workshop and interviews with members from Logius, the Tax Department, SBR Wonen, the Digicampus and DUO.

Due to the Coronavirus, all workshops and interviews will be held virtually. No recording is made of the interviews or workshops.

<sup>1</sup> For example: student, PhD, post-doc

**B) Risk assessment & risk management**

Please indicate if you expect any risks for the participants as a result of your research and, if so, describe these risks and how you will try to minimize them.

Minimal risk is expected for the participants since all interactions are performed virtually and no recording of the interactions are made. Input is written down separately and no names or personal information (if any is known) will be saved or distributed.

### III. Checklist

Question	Yes	No
1. Does the study involve participants who are particularly vulnerable or unable to give informed consent? (e.g., children, people with learning difficulties, patients, people receiving counselling, people living in care or nursing homes, people recruited through self-help groups).		x
2. Are the participants, outside the context of the research, in a dependent or subordinate position to the investigator (such as own children or own students)? <sup>2</sup>		x
3. Will it be necessary for participants to take part in the study without their knowledge and consent at the time? (e.g., covert observation of people in non-public places).		x
4. Will the study involve actively deceiving the participants? (For example, will participants be deliberately falsely informed, will information be withheld from them or will they be misled in such a way that they are likely to object or show unease when debriefed about the study).		x
5. Sensitive personal data <ul style="list-style-type: none"> <li>Will the study involve discussion or collection of personal sensitive data (e.g., financial data, location data, data relating to children or other vulnerable groups)? Definitions of sensitive personal data, and special cases thereof are provided <a href="#">here</a>.</li> </ul>		X
6. Will drugs, placebos, or other substances (e.g., drinks, foods, food or drink constituents, dietary supplements) be administered to the study participants?		x
7. Will blood or tissue samples be obtained from participants?		x
8. Is pain or more than mild discomfort likely to result from the study?		x
9. Does the study risk causing psychological stress or anxiety or other harm or negative consequences beyond that normally encountered by the participants in their life outside research?		x
10. Will financial inducement (other than reasonable expenses and compensation for time) be offered to participants?		x
<b>Important:</b> if you answered 'yes' to any of the questions mentioned above, please submit a full application to HREC (see: website for forms or examples).		
11. Will the experiment collect and store videos, pictures, or other identifiable data of human subjects? <sup>3</sup>		x

<sup>2</sup> **Important note concerning questions 1 and 2.** Some intended studies involve research subjects who are particularly vulnerable or unable to give informed consent. Research involving participants who are in a dependent or unequal relationship with the researcher or research supervisor (e.g., the researcher's or research supervisor's students or staff) may also be regarded as a vulnerable group. If your study involves such participants, it is essential that you safeguard against possible adverse consequences of this situation (e.g., allowing a student's failure to complete their participation to your satisfaction to affect your evaluation of their coursework). This can be achieved by ensuring that participants remain anonymous to the individuals concerned (e.g., you do not seek names of students taking part in your study). If such safeguards are in place, or the research does not involve other potentially vulnerable groups or individuals unable to give informed consent, it is appropriate to check the NO box for questions 1 and 2. Please describe corresponding safeguards in the summary field.

<sup>3</sup> Note: you have to ensure that collected data is safeguarded physically and will not be accessible to anyone outside the study. Furthermore, the data has to be de-identified if possible and has to be destroyed after a scientifically appropriate period of time. Also ask explicitly for consent if anonymised data will be published as open data.

Question	Yes	No
12. Will the experiment involve the use of devices that are not 'CE' certified?  <i>Only, if 'yes': continue with the following questions:</i>		x
➤ Was the device built in-house?		
➤ Was it inspected by a safety expert at TU Delft? <i>(Please provide device report, see: <a href="#">HREC website</a>)</i>		
➤ If it was not built in house and not CE-certified, was it inspected by some other, qualified authority in safety and approved? <i>(Please provide records of the inspection).</i>		
13. Has or will this research be submitted to a research ethics committee other than this one? <i>(if so, please provide details and a copy of the approval or submission).</i>		x

#### IV. Enclosures

Please, tick the checkboxes for submitted enclosures.

##### Required enclosures

X A data management plan reviewed by a data-steward.

##### Conditionally required enclosures

if you replied 'yes' to any of the questions 1 until 10:

- A full research application

If you replied 'yes' to questions 11:

- An Informed consent form

If you replied 'yes' to questions 12:

- A device report

If you replied 'yes' to questions 13:

- Submission details to the external HREC, and a copy of their approval if available.

##### Additional enclosures

- Any other information which you feel to be relevant for decisionmaking by the HREC.

#### V. Signature(s)

Signature(s) of researcher(s)

Date:

Signature (or upload consent by mail) research supervisor (if applicable)

Date: