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# Bottlenecks in the creation of data exchange interfaces and the vision solution offered by the research to automate the process through RIHA.

Master's thesis

Supervisor: Ermo Täks

Tallinn 2022

TALLINNA TEHNIKAÜLIKOOL
Infotehnoloogia teaduskond

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# Andmevahetusliideste loomiste kitsaskohad ja uurimustöö tulemusel pakutav visioonlahendus protsessi automatiseerimiseks RIHA kaudu.

Magistritöö

Juhendaja: Ermo Täks

Tallinn 2022

# Author’s declaration of originality

I hereby certify that I am the sole author of this thesis. All the used materials, references to the literature and the work of others have been referred to. This thesis has not been presented for examination anywhere else.

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01.05.2022

# Abstract

The purpose of this Master's thesis is to optimize and automate processes related to the creation of data exchange interfaces in the public sector through RIHA. The work highlights today's major bottlenecks in the RIHA information system and has compiled an analysis and a vision to expand the functionality of RIHA using process mapping. The scope of the work is limited to the stages in which the development of information systems is coordinated and preparatory activities are carried out for the establishment of data exchange interfaces in the public sector.

Through automation and the expansion of RIHA functionalities, the legal side of data inheritance would become easier and the process would become more transparent and understandable. The use of queries with redundant data would be reduced. Creating data queries through modern technological capabilities would also become more automatic and faster.

As a result of this work, it was established that it is very much possible to automate and simplify the “pre-processes” of the entire data exchange interface and the activities that precede it, with the help of various it tools.

This thesis is written in English and is 37 pages long, including 5 chapters and 17 figures.

# Annotatsioon

**Andmevahetusliideste loomiste kitsaskohad ja uurimustöö tulemusel pakutav visioonlahendus protsessi automatiseerimiseks RIHA kaudu.**

Käesoleva magistritöö eesmärk on optimeerida ja automatiseerida avalikus sektoris andmevahetusliideste loomistega seotud protsesse RIHA kaudu. Töös on toodud välja tänased olulisemad kitsaskohad RIHA infosüsteemis ja on koostatud analüüs ning visioon protsesside kaardistuste abil RIHA funktsionaalsuse laiendamiseks. Töö ulatus piirdub etappidega, kus toimub infosüsteemide arenduste koordineerimine ja ettevalmistustavate tegevuste läbiviimisega andmevahetusliideste loomiseks avalikus sektoris.

Läbi automatiseerimise ja RIHA funktsionaalsuste laiendamise muutuks lihtsamaks andmete pärimisega seotud juriidiline pool ja protsess muutuks läbipaistavamaks ja arusaadavamaks. Väheneks andmete liiasusega päringute kasutamine. Muutuks automaatsemaks ja kiiremaks ka andmepäringute loomine läbi tänapäevaste tehnoloogiliste võimaluste.

Esimeses peatükis tuuakse välja uurimistöö lühiülevaade probleemist, töö eesmärk ja metoodika. Teises peatükis on toodud detailsem probleemi kirjeldus ja uurimistöö peamised küsimused ning sihtrühmad, kes antud uurimistööga seotud on ning hetke ülevaade protsessidest. Kolmanda peatükis tuuakse välja küsitluse käigus saadud vastuste analüüsi tulemused. Neljandas peatükis on koostatud visioon kogu püsitatud probleemse protsessi parendamiseks ja automatiseerimiseks. Kogu uurimistöö kokkuvõte on koondatud viiendasse peatükki.
Antud töö tulemusena veenduti, et kogu andmevahetusliidese loomiseks ja sellele eelnevate tegevuste nö. eelprotsesse on väga palju võimalik erinevate infotehnoloogiliste vahendite abiga automatiseerida ja lihtsustada väga olulisel määral.

Lõputöö on kirjutatud inglise keeles ning sisaldab teksti 37 leheküljel, 5 peatükki ja 17 joonist.

# List of abbreviations and terms

| | |
|---|---|
| RIHA | Administration system for the state information system |
| RIA | The Estonian Information System Authority |
| ICT | Information and communication technology |
| MEAC | Ministry of Economic Affairs and Communications |
| NAO | The National Audit Office |
| ISKE | Reference system for security measures in information systems |
| X-Road | Highway for secure data exchange in Estonia |
| eID | Electronic identity |
| AvTS | Public information Act |
| AS-IS | Current model |
| To-be | What will be the new model offered |

# Table of contents

# List of figures

# 1 Introduction

Implementing a successful digital government requires a combination of many different factors that are highly interdependent. However, there are certain cornerstones that play a key role in the country's e-development. The development of E-governance has a very important role to play in the exchange of data, which aims to move towards the provision of the best possible service to the citizen. It is important to get the various national databases/registries on data exchange running successfully and to reach the level of trust of the citizen so that the citizen has confidence in the state, eDevelopment and Security. A high-quality dataset and rapid exchange of information between different systems is necessary for successful data exchange. And since one of the principles of the information society is that the free flow of data must be guaranteed, it is of the utmost importance that the resulting data be made available to all those entitled to do so.

The Estonian information Society Development Plan 2020 sets one of the main goals of the state to increase the well-being of people through information and communication technology (ICT). Much attention will be paid to the development of e-government and public e-services, finding that public e-services help save time and money for citizens and businesses alike. The goal of the development plan is to make all the most commonly used services simple, convenient and cost-effective. Many different public social services are planned to be personalised and prevented through ICT, thus bringing them to a new level of quality.

In addition to many other important areas, the Estonia’s Digital Agenda 2030 [1] has also taken the direction of data-driven governance and data re-use and leveraging digital changes in the public sector. The new development plan is a very good strategy for making the public sector more quality and successful.

## 1.1 Background and problem

The aim of this research is to highlight and analyse the problems and bottlenecks of the development of public sector data exchange interfaces and the management of the data sets of different national registers in connection with the state administration system RIHA [2].

The scope of the work is limited to the stages of coordinating the development of information systems and carrying out preparatory activities for the creation of data exchange interfaces in the public sector. The aim is to provide an analytical assessment of the existing model, which today is in use in the public sector, where data entry takes place in the RIHA management system [3], coordination of the information system to be created and developed, and further steps to create data exchange interfaces between information systems.

From a theoretical background: Estonia has established interoperability standards and guidelines for information systems aimed at ensuring the functioning of information systems [4]. Frameworks, regulations and agreements have been established for implementation: for service models [5], databases – AvTS [6, p. 5'1. peatükk], state IT interoperability [4] , open standards, state IT architecture, semantic description (methodology - [7], RIHA ontology - [8], semantic description guide [9]), information security - ISKE [10], state information systems development processes [11], use of free software, documentation systems [12]. These frameworks cover the architecture, integration, compatibility, interaction, consolidation and adaptability of information systems. The Government of the Republic has, by a regulation entitled “Fundamentals for the organisation of services and information management [13], set the objective of bringing the provision of e-services to a level where many services related to a life or business event are consolidated into a single event service. An event service consisting of several sub-services must appear to the user as a single, seamless service. Event services should, where possible, be provided proactively, i.e. at the initiative of the State, and should operate as automatically as possible for citizens [14].

One of the most important target groups would therefore be a citizen whose health and social well-being is of great importance and another target group would be the state, which should ensure the best possible provision of services to its residents. And for all

this it is necessary to have smooth and rapid data exchange interfaces between different national information systems [15].

Guidelines have also been drawn up by the Ministry of Economic Affairs and Communications (abbreviation MEAC) (28. 02, 2019). for the implementers of the regulation “Fundamentals for the organisation of services and information management” [16] .

From the NAO's 2019 report – “Management of public sector software development projects. Why are software developments failing?” [17, p. 43] - audits of various national development projects where one of the audited information systems was RIHA can be read. Reference should be made here to one important aspect, which the national Audit Office has also pointed out in its document [17, p. 22], that RIHA has failed to carry out a user satisfaction survey on this system. Asking for user satisfaction and feedback is one of the most important inputs for further developing the user experience of information systems at the next stages of the development of the information system.

On the basis of all this, this research is based on the nature of the RIHA data section that is already in existence today – managing the composition of the data. But also additional work for data exchange interfaces, which is not reflected in the management system of the RIHA information system today. And all the research is also based on feedback from different agencies that has been submitted through surveys in the framework of this research.

An important concern today is the situation where the datasets to be entered into the RIHA do not provide sufficient input to the new information system operators to be developed in the future for development and the creation of data exchange interfaces. The research will examine whether and how the expansion of RIHA functionalities for automation purposes would contribute and whether all this information and data can be exploited in such a way as to reduce bureaucracy, as well as financial and temporal resources for data exchange queries.

## 1.2 Statement of the research task

The aim is to determine whether the solution proposed as a vision would bring benefits to institutions using the RIHA administration system in the future or not.

Data exchange between different registers and information systems is very important both at national and international level. And if, due to a lack of information, there are errors in the creation of data interchange interfaces and the developments are stretched, this in turn makes it difficult to exchange data. As a result of this research, a compilation of conclusions and recommendations on how public sector data exchange interfaces could be implemented in Estonia more quickly and kept up-to-date.

Today, there have been major tiger leap-ups in e-government developments in further developments, but important problems have also arisen in the realisation of interoperability between different information systems, where different resource shortcomings (human resource with developments, time resource) as well as technical solutions in the creation/design/development of different new information systemsthat would require more modernisation and automation are cited as reasons.

The research problem has emerged on a need-by-case basis where, having encountered the need to create a data exchange query with different national data registers/information systems, which is mostly very time-consuming, full of red tape and a very large amount of time, money and human resources. The execution of a data exchange query between two different information systems has not been performed or is pending until the data administrator has the opportunity to make the query. Alternatively, in this case, there is a choice where queries with redundant data are also issued, which is again not correct from a data protection point of view.

## 1.3 The main hypothesis of the research

The development processes of data exchange interfaces are in poor shape in Estonia and differ from organisation to organisation. It is necessary to find a solution for automating the development of data exchange interfaces and making it legally unambiguous.

The analysis highlights the current problems in the various stages of the development of data exchange interfaces, from the emergence of the need to the implementation of the

developments. In addition, based on the outcome of the analysis, the author has developed a vision for a solution that would also help to propose the possibility of reducing the problems and duplication of activities arising from red tape in the future by expanding the functionalities of the management system of the RIHA infioste system. As a blueprint, the legal control of data queries would take place in a single environment, and data owners can quickly assemble correct queries for data users. The research results in an overview of how the various stages of the process can be simplified and automated using different technological options using more automated static code generators.

In Estonia, there are standards and specific query forms that are used across the secure x-Road. The known format and data field names provide an opportunity to generate a static code generator for an automatic data exchange query that would produce an output corresponding to a specific data query. In this process, the data owner can link the output already provided to his or her own database, which provides only access to the authority for inquiries.

By simplifying and aggregating automation and duplicative external processes, the aim is to:

- simplify the legal side of data inheritance and make the process more transparent and understandable.

- reduce the use of redundant queries. Data managers should not use queries with redundant data to save resources.

- accelerate the creation of correct queries through modern technological opportunities: If there are data field formations or lists in RIHA, the information system engine could be genitalized in the future like the correct query “Lego blocks”.

## 1.4 Research plan

The analysis carried out in the course of the research has several milestones:

- *Mapping the existing process, analysis.*
- *Get an overview and get the problem places out in more detail.*
- *Proposals and vision for enhancing data exchange interfaces through the RIHA management system.*

## 1.5 Research framework

The research first highlights the processes and perceptions of today's situation in creating data exchange interfaces and the concepts, advantages and disadvantages of using RIHA. The analysis describes the overview of the situation and also highlights the reference moment as a result of the planned potential solution offer.

## 1.6 Methodology and methods of data collection

The author used a quantitative method in the research [18], in which he conducted a study to obtain an overview of the current RIHA user assessments and daily practices in creating data exchange interfaces and the preliminary work on creating interfaces. The author examined opinions and attitudes about the current situation regarding the processes performed in the database of the state information system management system. How data entry processes are happening today and whether they will work as expected or not. In analysing the processes of the creation of different data exchange interfaces and the activities prior thereto, the author combined design thinking and business process management visualisations with different software for automating and improving the current architecture as well as the vision for the management system of the RIHA information system. The vision solution proposed as a result of the research would simplify future stages related to the development of data exchange interfaces, from the emergence and analysis of the need to development.

The collection of research materials was based on both methodological and practical aspects. Methodically, the process of developing data exchange interfaces was described as different stages. Each step was given its own purpose – for example, an analysis of the need for a dataset and a description of the purpose of that stage. The research also carried

out an analysis of the legal phase of the development of the data exchange interface – how today the legal side is involved in this process and to what extent this process can be simplified and automated, if possible. The practical aspects were grouped together on the basis of the organisational practice of the institutions involved in the study, as well as by mapping, examining and analysing the practical experience of those who are the focus of the research.

The material was collected using surveys across the web and an analysis of the current situation was carried out – how data interconnection processes with their concerns and solutions are in the public sector today. Various analyses and reports previously carried out were also examined, which were implicitly or even more closely related to the subject. During surveys examined more general attitudes and perceptions about data exchange interfaces, RIHA performance and usability. In addition, the methods of organisations at different stages of the creation and development of data exchange interfaces were examined today. The study also analysed the user's visions and visions to improve the ease of use and effectiveness of RIHA.

The results of all surveys were analysed in parts and the different stages were compared according to the process. Points where the process activities in creating data exchange interfaces and entering/using the RIHA dataset are similar or the same as well as common bottlenecks or problems were identified.

## 1.7 Design thinking and visualisation of business processes

The user-oriented approach to process mapping is one of the important directions today. The focus will be on the person targeted by the solution and a visual process mapping will be created. *"Design thinking is a creative and user-centric way to solve a problem."* [19], [20]. A simpler design thinking approach consists of defining a problem, comparing needs, thinking, building a new process and testing. This approach is used on a daily basis, especially in larger companies and in mapping more complex processes, where it is intended to innovate processes and introduce new innovative solutions. Design thinking and mapping business processes make it a good idea to get a visual overview where you can change patterns and bring in automated activities.

## 1.8 Tools used in research

One of the primary tools the author used was Xmind [21]. This is about visually designing thought cards. This concept was developed by Tony Buzan in the 1970 s. This tool is used successfully for brainstorming, with one central theme around which different processes take place. Used primarily to find solutions to problems.

Another tool was the Arch modelling tool [22]. It is an open source modeling tool kit for creating ArchiMate models and sketches [23] [24]. With this tool, the architecture of the enterprise and information system can be described through different layers and models, analysed and visualised within the processes of business areas, as well as the relationships between the processes.

The third tool used by the author was SAP Signavio process Manager [25]. This tool is analogous to the Bizagi [26] tool, where professional business process modelling can be performed. The tool enables organizations to document, model, plan, and simulate processes and sketch their interconnectedness.

## 1.9 An overview of the research

This work consists of 5 chapters:

Chapter 1 - consists of an introduction to the research and gives a brief overview of the problem, purpose and methodology of the work.

Chapter 2 - a more detailed description of the problem and the main issues of the research and the target groups involved in the research will be highlighted. An overview of the current process is also retrieved.

Chapter 3 - the results of the analysis of the responses received during the survey are highlighted.

Chapter 4 - a vision is outlined to improve and automate the entire persistent problem process.

Chapter 5 - Summary of the research.

# 2 Description of the research

As a result of the research, a visionary solution is proposed through process automation and simplification at various stages of the establishment of a data exchange interface. Today, the processes are very large, with duplicative activities and RIHA users (describers/internalisers of information systems) cannot understand the real purpose of RIHA.

## 2.1 Research questions

In view of the problem, the following research questions are the subject of research:

- *What are today's best practices, key process activities and more positive results for the different stages of creating data interchange interfaces?*
- *What are the bottlenecks and biggest problems in this process today, their causes and user experience?*
- *What are the user's visions and visions for improving the creation of data exchange interfaces in the future?*
- *How and where is the legal control of data queries today and the compilation of correct queries that meet the needs of data seekers, in the example of different organisations?*
- *Is the vision offered by the research to automate processes for creating data exchange interfaces one of the points of interest for public sector organisations and individuals? How can the development phases of data exchange interfaces be automated?*
- *What are the possible solutions?*
- *How do I reduce the use of queries with redundant data?*
- *How do I speed up the creation of correct queries?*

## 2.2 Audiences/communities benefiting from this study

An empirical formula was used to target the research. The empirical section searches through analysis for answers to questions about the bottlenecks and problems of using the RIHA administration system today. The main research questions are based on the assumption that the development of each data exchange interface is linked to several different processes and the needs and resources of several different institutions. Thus, the coordination and process of the development of each data exchange interface involves different organisations at the same time.

The selection of the sample was based on the principle that the focus of the investigation will be on people involved or participating in various development projects or coordination at different stages in the creation of the data exchange interface.

These are people who:

- use descriptions of information systems in the RIHA management system;
- coordinate different databases/information systems in RIHA;
- dealing with the legal side of the data exchange interfaces;
- plan various resources and development activities from the establishment of the information system to the development.

In total, 15 different specialists from local governments and state agencies participated in the survey with a ratio of 4 state agencies and 11 local governments.

If the vision solution offered as a result of this research also reaches realization, it would benefit all organizations exchanging data via the x-Road who come into contact at any stage of development from planning the data exchange interface to development.

## 2.3 Today's current status, theoretical framework and lenses

The information system of the RIHA management system has been established in Estonia, where it is necessary to describe in great detail all data fields and their rights upon the establishment of the information system. This is the national information System Management System (RIHA) [2], which requires detailed coordination of the foundations

of information systems beforehand, and further coordination of the statutes and use of information systems. One of the main needs is the detailed dataset that is collected somewhere in the information system/register. On the basis of all the information to be entered, a very important principle could be applied today – the one-off submission/request of data from the citizen, i.e. the once-only (OOP) principle [27], which is a major part of the interoperability of information systems. Interoperability is one of the factors that helps the public sector and the e-government to achieve the best potential in providing services to citizens. This is also reflected in the document "Review of InteroperabilityStandards and initiatives in electronic Government" [28].

The research identified the experiences and assessments of different users as to whether and why this platform is only a visual aid tool today. Today, the data has been added as files that are very large and have not always been updated across recent developments. Large data set files are difficult to manageable, and finding the correct data field descriptions is difficult. As each data exchange interface requires developments both from the person who performs the data query and from the data manager, the survey revealed that the preliminary work and developments to realise the developments are problematic and entangled by the national data managers just behind the time resource.

The research also analysed whether the possible widespread management of the description of the data composition of the RIHA would provide an overview of which data set should be described in more detail in order to ensure information about the source of the data, i.e. the source of the data.

An information Development Plan has been established in Estonia in which the basic principles of information policy and service-based architecture have been agreed, security of data and data exchange, including the reference system for security measures for information systems (ISKE), web-based, orientation towards e-services and the use of strong authentication tools. The basic infrastructure of the state information system, i.e. the infrastructure of services (X-Road, public key infrastructure and eID, document exchange environment, information gateway eesti.ee), has supported the development of public services through years with fast and flexible ICT solutions.

Different datasets and data exchange interfaces shall comply with the interoperability framework. The usefulness, if any, of this framework if not all public sector organisations understand the need for development of data exchange interfaces and do not implement it unambiguously in the best possible way. In order for the data exchange to work

successfully, it is necessary to exchange the necessary data through agreed development models.

## 2.4 Different mapping of the steps required for the data exchange interface in AS-IS

### 2.4.1 Xmind mapping

Figure 1 shows the main points where the various institutions have to take certain steps in a uniform way in RIHA. Next steps for data exchange interfaces – data search, creation of contracts for data exchange and the interfaces to be developed are performed outside RIHA and there is no overview in RIHA – whether these interfaces have been realised or not.

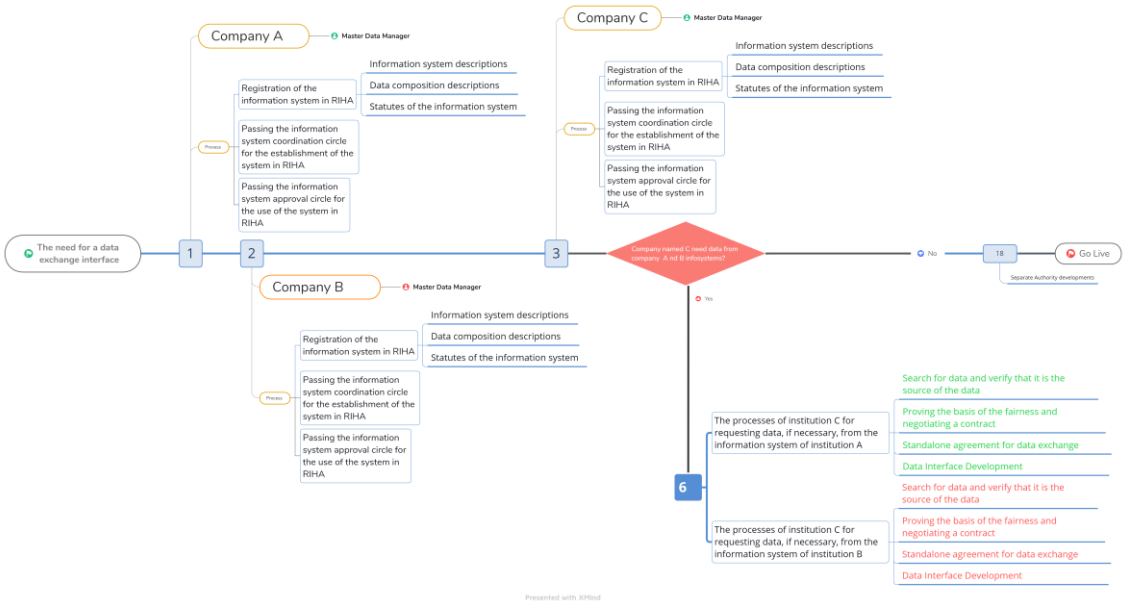


Figure 1. Xmind [29] process diagram with different institutional steps version 1 (created by author)

### 2.4.2 AS-IS ArchiMate process mapping

The following visual AS-IS mapping has been compiled using the ArchiMate tool, which mapped the current process. This model is based on information obtained from surveys compiled by the author and largely on the basis of the author's personal work experience. This figure is one of the visual comparison tools for the TO-BE models in the following sections.

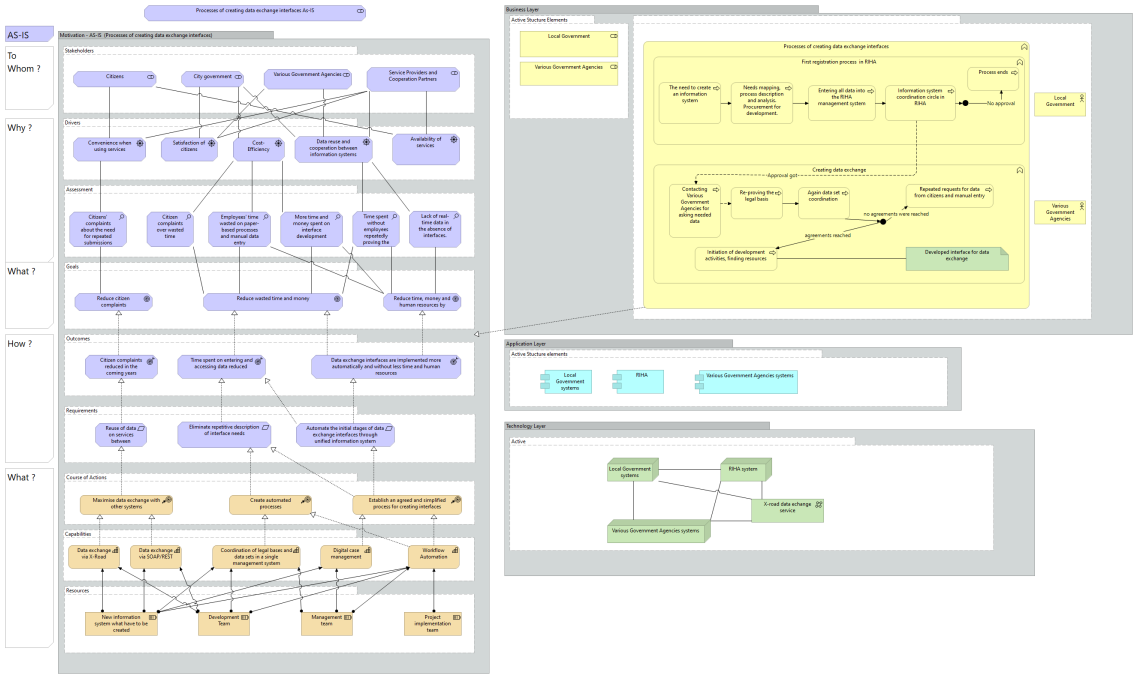


Figure 2. AS-IS ArchiMate [30] model view (compiled by the author).

For better quality, this image is shown separately in the following images as each block.

### 2.4.3 AS-IS Motivation Model

The motivation model (Figure 3) gives an overview of the strategy, values and stakeholders and drivers of change in the process. The main objectives, root causes and requirements for further process automation are outlined. The motivation view is based on questions: to whom, why, what, how, what are the prerequisites and resources for the change to take place.

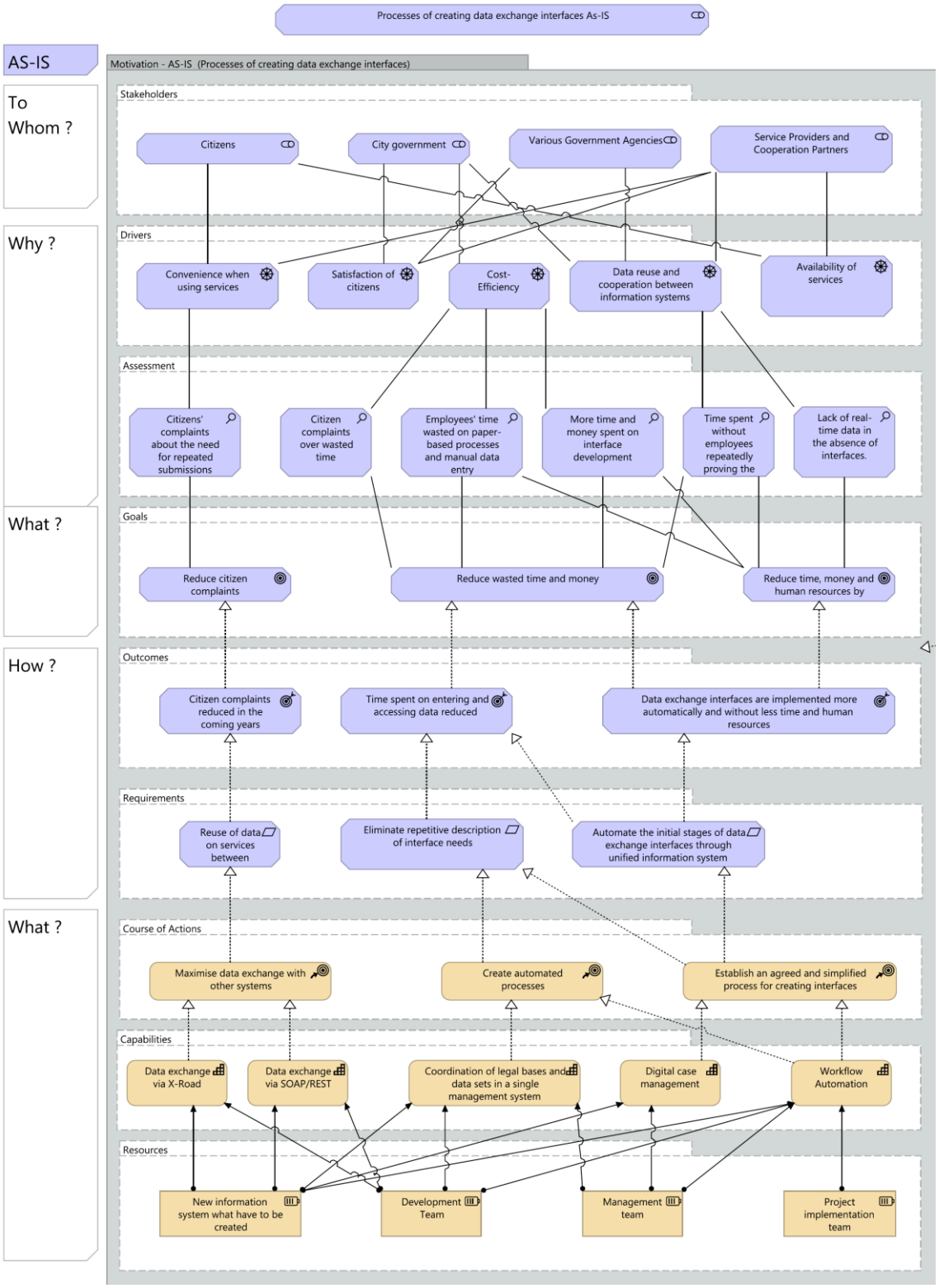


Figure 3 AS-IS ArchiMate model view Motivation Layer (compiled by the author).

### 2.4.4 AS-IS Business Process Model

Figures 4, 5 and 6 focus on user roles when using “pools”-style process mapping as layered views. The lower layers (figures 5 and 6) consist of applications and application services. This is a comprehensive overview of the purpose of the arena, the path of the user, and the process. without the need for BPMN modeling. In addition, this view allows you to connect process steps to the actual application. “Creating data Exchange” in the figure is an activity that must be performed with each data field manager individually.

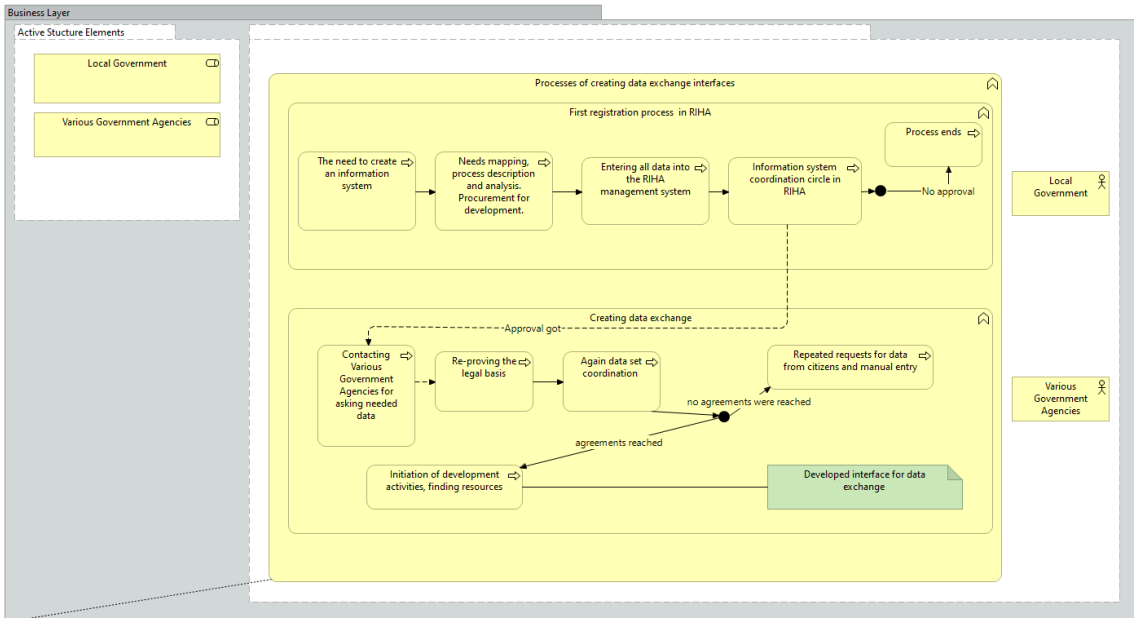


Figure 4. AS-IS ArchiMate model viewBusiness Layer (compiled by the author).

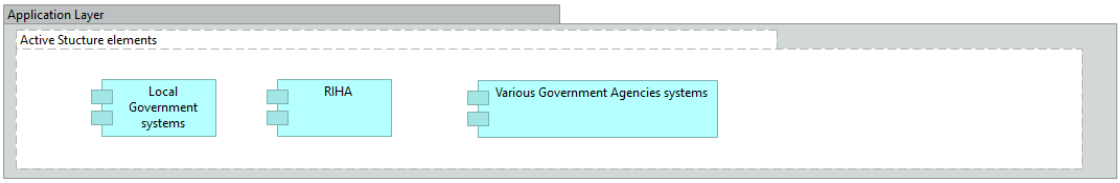


Figure 5. AS-IS ArchiMate model view Application Layer (compiled by the author).

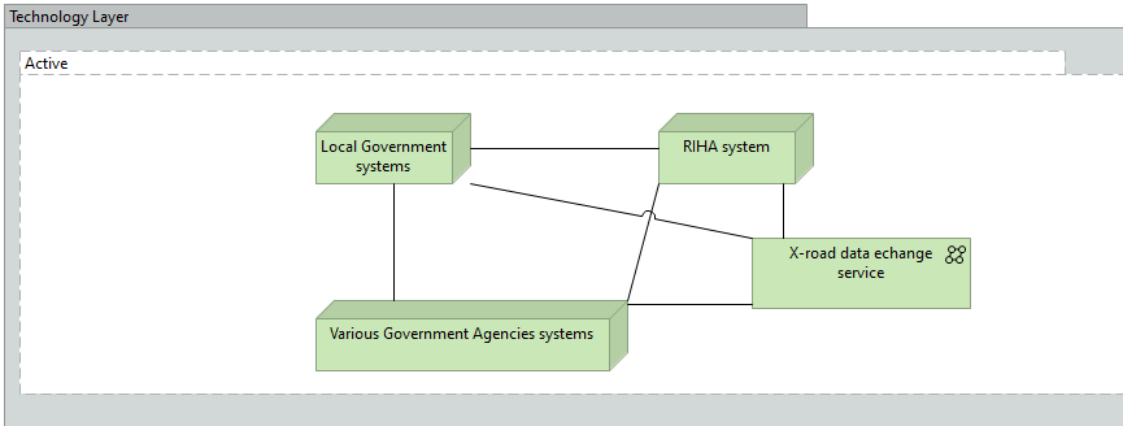


Figure 6. AS-IS ArchiMate model view Technology Layer (compiled by the author).

### 2.4.5 AS-IS Simplified Business Process Model – Signavio

Figure 7 shows today's first stage for registering the information system in RIHA. searching for data for the data exchange interface, proving the legal bases for obtaining data and concluding contracts upon reaching agreements is separate from RIHA today and RIHA does not have the opportunity to get an overview of the information system administrators of which interfaces are used in the information system. The source sources of the data, i.e. who are the administrators of the data – the composition of the data in the description of each information system must be drawn down in order to search for them, but whether the actual data exchange has been carried out – there is no marking on this.

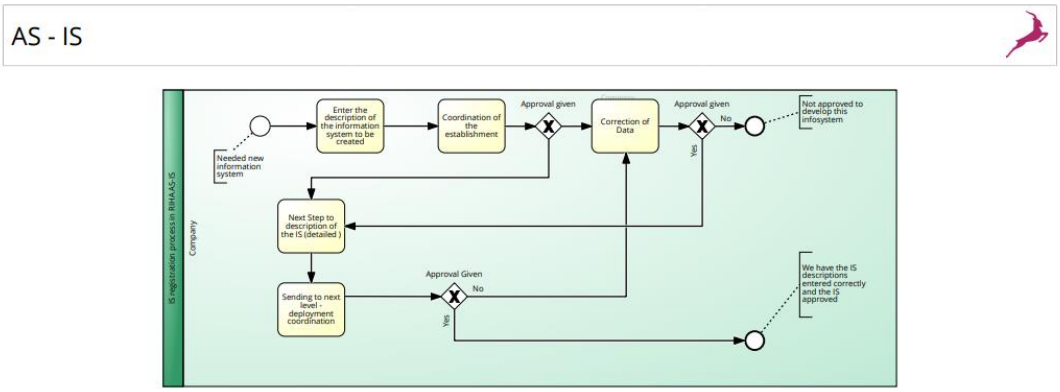


Figure 7. Figure of AS-IS Signavio [31] mapping for the registration and coordination of a single information system(compiled by the author).

### 2.4.6 AS-IS Business Process Simplified Relationship Model - Signavio

Figure 8 shows today's duplicative activities in creating data exchange interfaces between different parties.

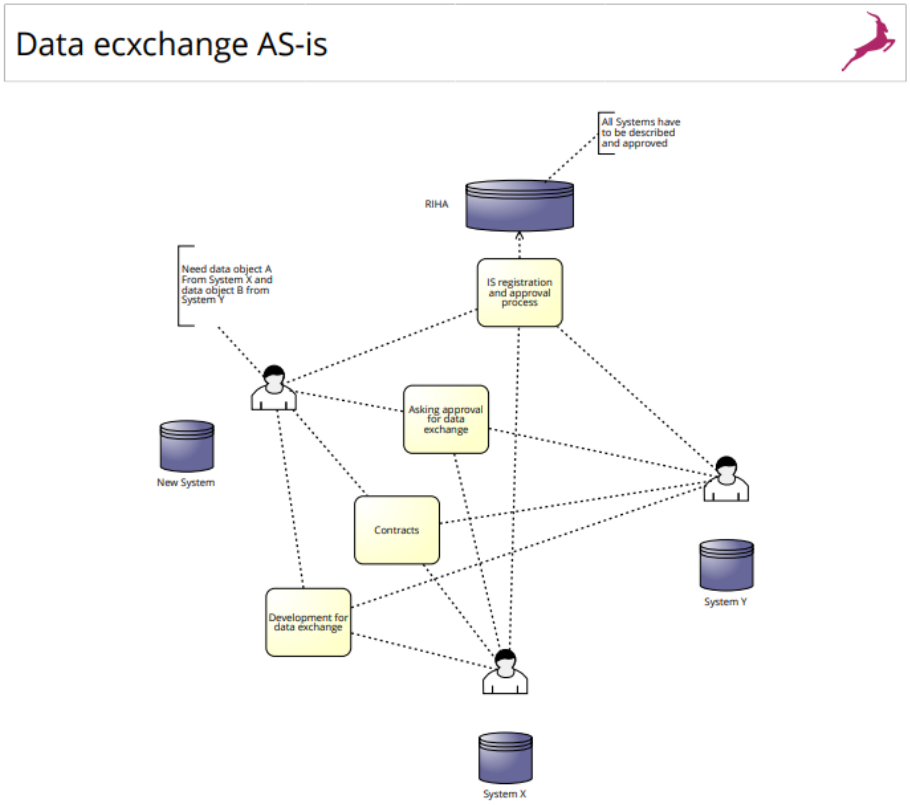


Figure 8. Data Exchange management AS-IS - Signavio (compiled by the author).

### 2.4.7 AS-IS Mindset solution for creating an interface for data exchange in a business process

Figure 9 shows the main activities currently using the Xmind action axis.

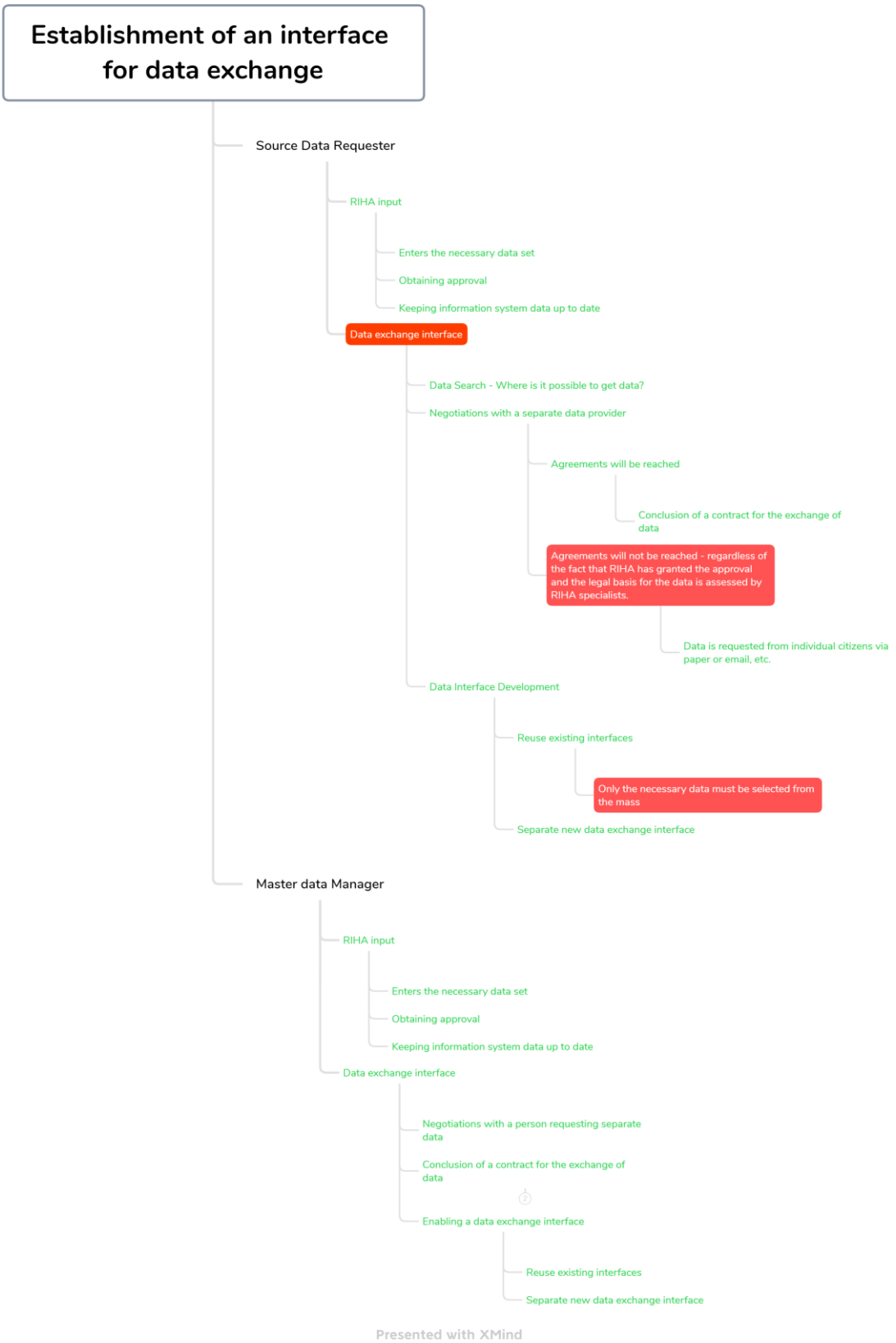


Figure 9. Steps required for the Xmind AS-IS data exchange interface (created by the author).

# 3 Analyses and results of the research

The research revealed a number of bottlenecks and problems that require more detailed review and automation/simplification. The respondents to the survey unanimously revealed by all respondents that at present the possibilities of different technologies are not sufficiently exploited and duplication takes place in several places and the perceptions and legal bases for creating data exchange interfaces are interpreted differently. There is a very high proportion of duplicative bureaucracy that can be significantly reduced. 100% of respondents identified this problem.

In 14 out of 15 respondents, you can exclude from the workload of officials that filling in the RIHA dataset and creating data exchange interfaces is a very large waste of time resources that could be successfully applied to automate and make the whole process more transparent. In the course of the research, the first steps were mapped in which steps automatic models of information systems can be used.

As a result of all the research, the problem areas arising from the human factor went through several times, where, when the representatives of the organisation changed, the views on the interpretation of the legal bases also changed and this in turn has been a hindrance to the creation of fast data interchange interfaces.

In the public sector, the succession of data from other state information systems has always been regulated in detail and it has been specified what data sets are necessary for which activity or activity. Continuous and long-term analysis and repetitive evidence and retrieval of legal bases is time-consuming work in this process. However, if the RIHA dataset is coordinated in the information system of the management system of the RIHA, a detailed analysis of the dataset is already carried out there – it is ensured that the dataset of the information system to be created is not repeatedly generated and if the data is already used in some registers, the data must be retrieved from the main data database through queries. Here, however, problems arise where the RIHA coordination round is not considered sufficient and the legal basis for requesting all data must be resubmitted and applied for when addressing each organisation.

## 3.1 Research - search for required data fields

The search for administrators of the source sources of the necessary data fields is today a very big challenge for the authority that will establish the information system. This is an

even bigger challenge if it is a specialist with little experience who has not been in contact with previous processes and is not aware of where one or the other dataset is registered as basic data.

While you can search for RIHA data, you can search for the necessary data field, but the result is a very large dataset that requires further analysis. It is not possible to search further only for those that are national primary basic databases. So what can be explained here is that when you look for a data field called “residence,” as of May 2022, 303 results were returned. The result includes all of the data fields that contain the given name, and it is not clear which of these are 1 and correct, which data field should be used as the basis first. On this basis, this point is the first critical point of contact for the creation of data exchange interfaces.

## 3.2 Research - different practices and processes using RIHA

The research examined their experience with the use of RIHA from users of different institutions. The result revealed that many smaller local governments would prefer to use standard solutions already in use nationwide. At the same time, it is also necessary to register the use of standard solutions in the RIHA. and this also revealed the concern about duplicative activities (where each phase of integration with the main database should be handled separately with all data managers), the agreement of the provider of the standard solution must be obtained separately from all data managers and then re-registered as a user of the standard solution by the authority wishing to use the solution and it must also resubmit it to the coordination round. Smaller local governments avoid the development and registration of the whole information system from scratch because there is insufficient IT capability to go through the bureaucracy of the whole process.

Time-consuming communication with the RIA and actions to introduce improvements in the coordination rounds were also highlighted. It is very slow to get feedback on the improvements and, rather, the person entering the new information system will be directed at the various extensive instructions without giving any human explanation of the problematic places that the coordination has created the problem and abandoned the coordination.

The shortcomings also highlighted the requests for contract bases and data exchange interfaces directly from the RIHA system.

The provision of data exchange interfaces highlighted a number of different situations where existing queries were offered as data exchange interfaces, where the person who performed the data query was obliged to filter the necessary data fields on his server. Consequently, there is a redundancy of data – where the person who queries the data actually obtains more data than is actually necessary. Another aspect was the time spent – where it has taken a month to 9 years to create data exchange interfaces. There were also situations where, as a result of the RIHA coordination round, it had been confirmed that there was a legal basis for obtaining the data, but in reality the data exchange interface had not been made possible by the data manager, on the basis of the position of a specialist of the given authority, where the authority, as a result of the interpretation of the Regulation, considered that there was no legal basis for obtaining the data.

## 3.3 Research – Coordination rounds in RIHA as the basis for obtaining data exchange interfaces

Various stages of registration and approvals take place in RIHA each time the information system is created. different national authorities are involved in the entire coordination cycle by the RIA.

The information system shall be coordinated by the information System Authority, the data Protection Inspectorate, Statistics Estonia, the Land Board and the national Archives. Extract from the RIHA approval page [32]:

- *Upon approval, Statistics Estonia shall assess and verify the documentation of databases in accordance with clause § 9 subsection (2) p. 4) and § 29 subsection (2) of the Official Statistics Act.*

- *Upon approval, the State information System Authority shall assess and verify the technical compliance of the documentation of the database, the composition of the data collected and the compliance of the sources with the requirements established by legislation and adherence to the principles of administration of the*

*state information system and ascertain whether and which basic data are collected.*

- *Upon approval of the documentation of the database, The Data Protection Inspectorate shall assess and verify the compliance of the organisational and information technology requirements of the database, including the composition and sources of the data collected, with the requirements of the "Public Information Act", in particular the need to impose restrictions on access to the data of the database or compliance with the obligation to disclose the data of the database, and with the requirements of the "Personal Data Protection Act", in particular compliance with the principles of processing personal data and the adequacy of the security classes and measures of the database.*

- *Upon approval, the Land Board shall assess and verify the compliance of the organisational and information technology conditions of the documentation of the database with the requirements for the processing of spatial data provided for in the spatial data Act, the management of spatial data sets and the provision of spatial data services.*

- *Upon approval, the National Archives shall assess and verify the technical functionality of the documentation of the database in connection with the capability to export the archives in accordance with § 7 and § 8 of the Archives Act.*

As a result of the coordination, the objectives and data composition of the entire information system to be created shall be assessed in detail. As a result of the study by the various respondents, it was found that the legal bases and assessments provided are negligible in the eyes of data managers (the role of the establishment that should issue data through data exchange). The whole process, verification and application of the legal basis for obtaining the data, negotiations and the conclusion of the agreement will be duplicated again and the outcome may not be the same as that of the decision given in the RIHA coordination ring. As a result, a single authority gives consent and confirmation to the movement and exchange of data, but the data administrator does not agree to issue the data as a result of different interpretations of the Regulations.

The examination of this point also revealed that this is part of a very time-consuming and problematic process in which it would be possible to make the process simpler, more transparent and faster. The whole process should be based on the immediate involvement of data managers in the coordination ring, who are indicated in the data composition that they want to start requesting data through queries.

## 3.4 Research – applications and contracts for the establishment of data exchange interfaces

The research also analysed the next phase of the process, which involves the submission of requests for data and the conclusion of contracts between different parties. The activity takes place separately from RIHA and no indication of what is happening in RIHA is entered. However, this process could be significantly more automatic and transparent if the activities were also related to the coordination round and the agreement of the necessary regulations for data exchange directly within the RIHA. If it is assassinated in the data set of the information system to be created that certain data fields are planned from another information system that is already registered with the RIHA and is the main source of data, it is not clear why it is still necessary to submit a separate application for this purpose. This process could continue more automatically in the future - an agreement/arrangement between the parties would be concluded directly at RIHA to realise the data exchange interface, if necessary, in order to realise the reviews and consents received in the coordination round.

The result would also be a coherent overview for the body with which contracts have already been concluded and for which data. A technical solution with this vision would also provide an overview of the data fields that institutions use specific data fields in the future.

## 3.5 Research – an automated module for creating data exchange interfaces

In the course of the research, 15 participants from both state institutions and local governments were offered a model in which different technological capabilities of the present day are used to create data interfaces, where an automatic code generator can be

applied here due to a specific predefined structure and the code underlying the development.

Realisation of the solution vision offer would result in a single engine that would assemble queries with the necessary datasets without redundancy of data. The entire automation would be based on the process of selecting specific data fields and the system would already generate the input and output of the corresponding query for a specific interface, which could then be implemented by both the data administrator and the data query maker into their registers.

This would lead to a very significant reduction in the various resources required for development (both financial and temporal).

## 3.6 Additional arguments for getting feedback from study participants

Subjects were also given the opportunity to include their opinions and thoughts on the use of RIHA. In addition to the time-consuming communication with the RIHA team outlined above, the topic was highlighted on several occasions that the institutions do not have the benefit of meeting the requirement for registration and coordination of the information system in RIHA.

It also highlighted a topic in which the local government has the right to obtain data from the administrators of the original sources of data when performing certain public tasks, i.e. the local government has the right to access certain data when performing tasks. However, the result is partially missing data interchange interfaces, as the data administrator's representative interprets the local government's public mandate differently. And through this, citizens who are consumers/users of local government services and have to transmit the necessary documents or evidence on paper, by email or in some other way are once again affected. There is an unreasonable duplication of data and the procedure for receiving support for the service or local government is stalling. It is also not possible to provide citizens with the best e-services if the input data necessary for the service cannot be retrieved from the data manager, i.e. the data cannot be accessed through automated interfaces.

90% of the local government participants who participated in the research also pointed out the lack of labor resources. There is not enough team to handle data entry in RIHA. Based on this, priorities have usually been set in local governments, where the availability

of IT infrastructure and services to citizens must be ensured first and only then. In addition to the main work, attempts are made to enter the necessary data in RIHA.

The authorities feel that the RIHA has been set up only as a monitoring mechanism and that the authorities have not been provided with any support services provided by the state for entering and maintaining the RIHA documentation.

It is also incomprehensible to require different additional activities by the state, where legal unregulated data have not been regulated, which could automatically use the RIHA itself in classifying the so-called open data directly to the open data portal. For this purpose, different institutions have once again been put on top, where all data fields suitable for opening data in the different information systems of the institutions must be identified in the tabular software in Excel. At the same time, if these data lists exist in RIHA, in the future this need could also be successfully covered by RIHA automation, where the system generates the data fields allowed as open data directly into the output of open data or transmits information about open data directly to the open data portal via the interface.

# 4 Vision

As a solution to different aspects of the entire research, this chapter proposes different solutions to improve and automate the entire persistent problem process.

## 4.1 Improve field search

It is important to create an opportunity where it would be possible to get a detailed overview of the main data databases, ie where the primary source and the main administrator of a certain data field are. The management of all fields should become easier to manage and modify. To change the entire data set, the data set should not be re-uploaded as a file, but it should be possible to manage the data fields separately without file management. This solution was available in the previous version of RIHA, where in addition to uploading the data set with a file, it was also possible to add and manage data fields one by one. In this case, removing or adding individual data fields would be easier, faster and significantly more economical.

## 4.2 Extension of RIHA coordination rounds

One important aspect would be to increase the coordination round in RIHA at the expense of the authorities that provide the data. If a data field is indicated in the data set which is not part of the main dataset of the information system to be created and moved to the approval, it is important to include the administrators of the main data in the coordination round immediately.

This process would significantly reduce later disputes and duplicate activities to obtain data exchange interfaces.

## 4.3 Requests for data interchange interfaces, contracts and generator and descriptions for the creation of data interchange interfaces in a single system

All activities with data interfacing interfaces – applications and contracts to be integrated into a single system, with automatic generation of data interfacing interfaces, as well as coordination and agreements.

## 4.4 To-Be Mapping of the Vision Solution

The following visual To-Be mapping is compiled using the ArchiMate tool, where the desired result process was mapped. Comparisons of As-Is and To-Be are shown in the following figure.

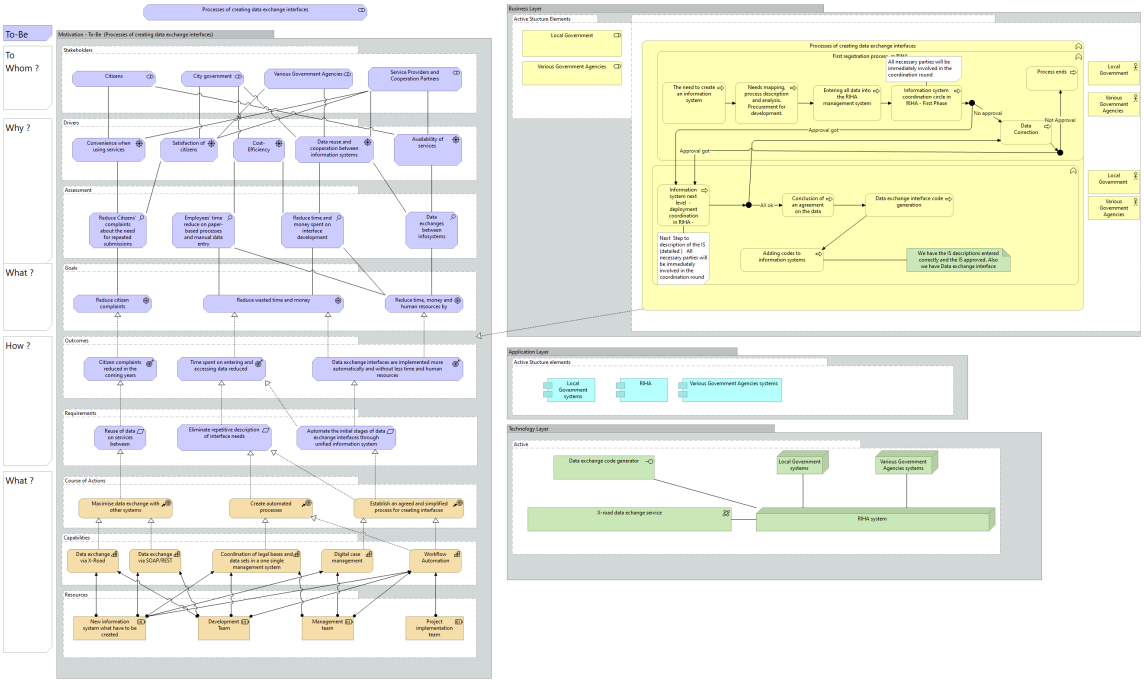


Figure 10. To-Be ArchiMate model view (compiled by the author).

### 4.4.1 To-Be mapping through the motivation model

In the To-Be model, the analysis has reduced perceived weaknesses in the process.

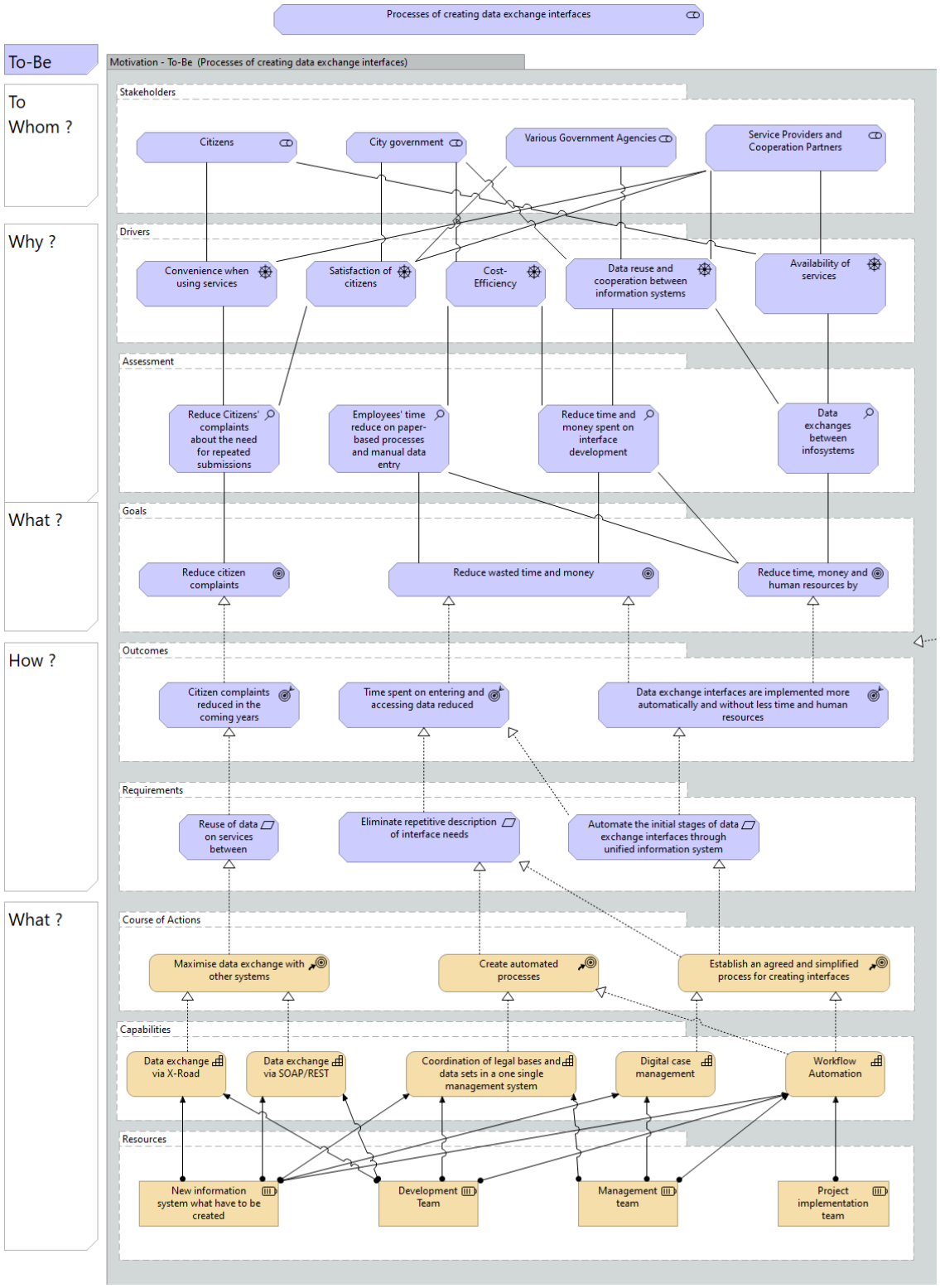


Figure 11. To-be motivation Layer view - ArchiMate (created by author).

### 4.4.2 TO-BE Business process Model

Figure 12 uses simplified “pools” style TO-BE process mapping to focus on user roles as layered views. As a result of automation, the desired solution results in all activities being concentrated in one place – the RIHA management system. It is intended to exclude the processes performed outside this information system today, which are time-consuming and bring all activities together through automation and harmonisation. THE TO-BE model would provide for the involvement of more parties in the coordination circuits of information systems, the conclusion of contracts and agreements directly within the RIHA according to the outcome of the coordination. And also immediately through the “mapping” of data fields the generation of the codes necessary for the data interface using the code generator of the information system.

In Figure 14, the visualization of relationships has become easier.

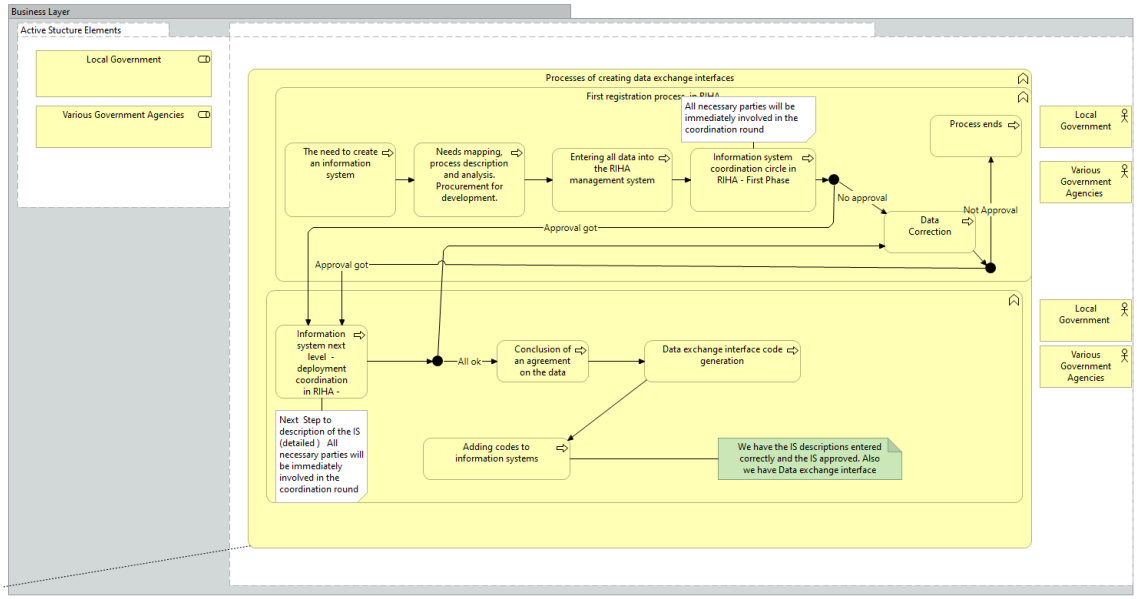


Figure 12. TO-BE Business Layer View - ArchiMate (created by author).

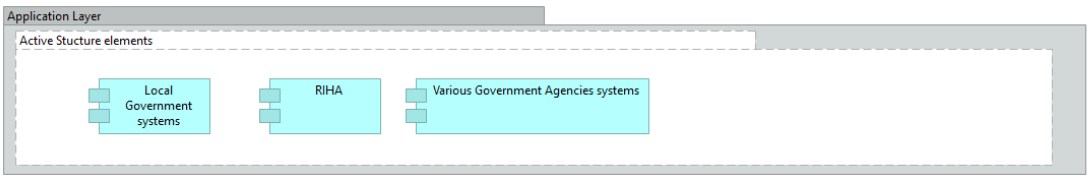


Figure 13. TO-BE application Layer View - ArchiMate (created by author).

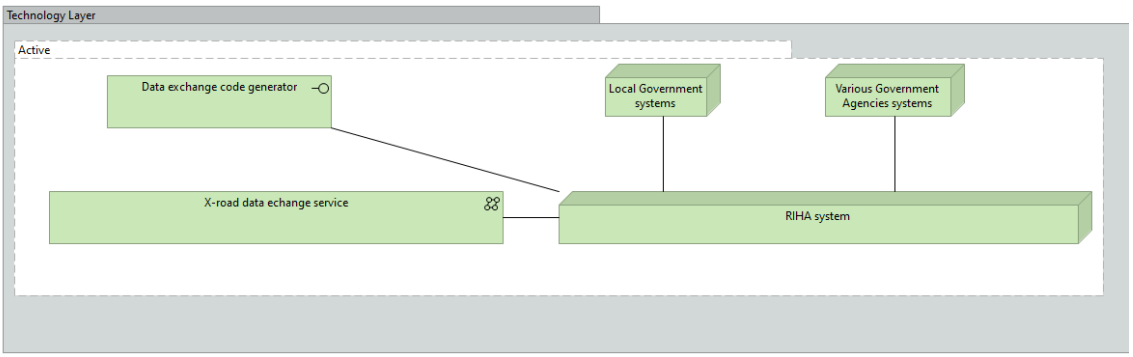


Figure 14. TO-BE Technology Layer View - ArchiMate (created by author).

### 4.4.3 TO-BE Simplified Business Process Model – Signavio

Figure 15 shows the process drawing with the expected result when registering the information system in RIHA. the biggest change is the consolidation of all activities into one information system – RIHA.

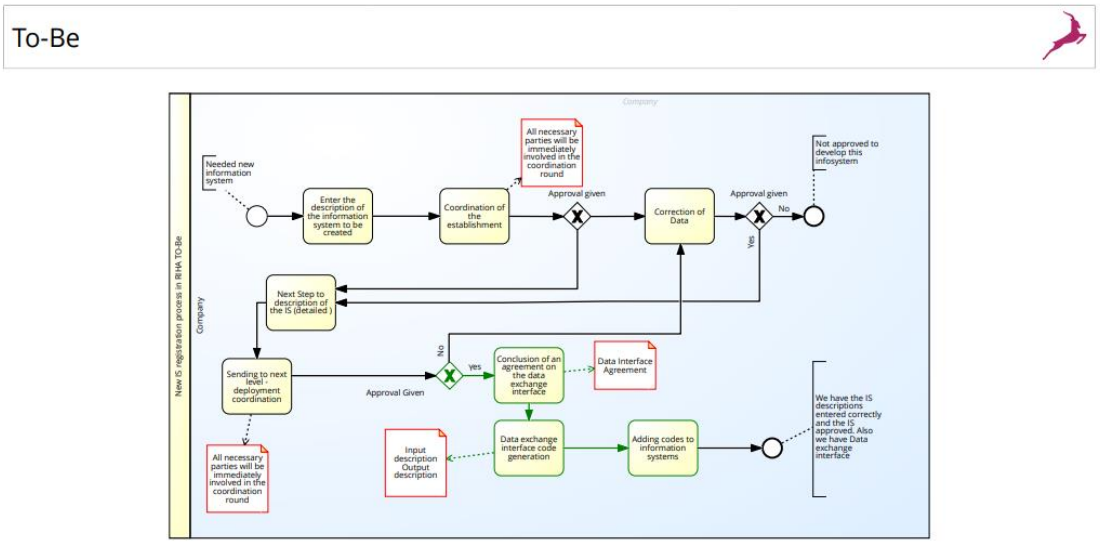


Figure 15. TO-BE vision processes - Signavio (created by the author).

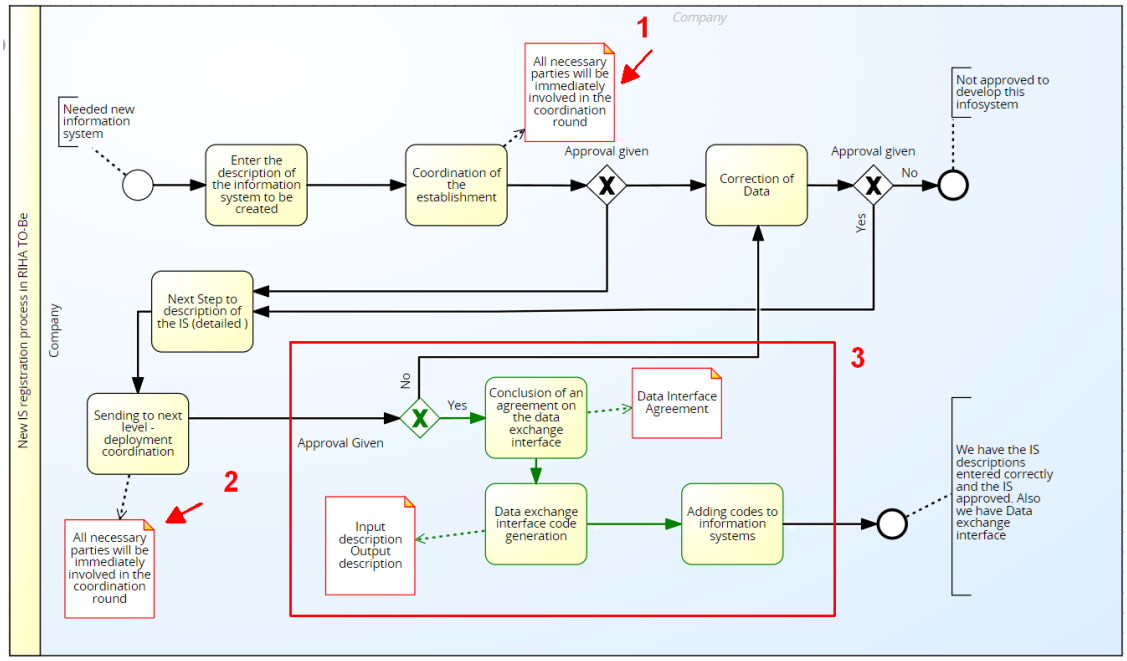


Figure 16. TO-BE process Signavio - with differences compared to the AS-IS process (compiled by the author).

This figure shows 3 differences in the mapping of AS-IS and TO-BE processes.

The difference between No. 1 and No. 2 shows the involvement of all parties in the information system coordination processes. Here, the author means the involvement of those parties who will start transmitting data to the information system to be created in the future.

The difference between No. 3 is the activities performed as external activities in the entire AS-IS process, which according to the TO-BE mapping should be implemented in the future as a uniform and automated process in the entire information system coordination and description process at RIHA. For the conclusion of agreements, the formalization of contracts for data exchange interfaces between the parties and the selection of data fields using the possibilities of a code generator - immediately creating both input and output codes for the data exchange interfaces for both parties.

### 4.4.4 Relationships in the TO-BE process Signavio

In Figure 17, the relationships have become easier compared to the AS-IS model. Communication and agreements take place in one information system and it is not necessary to perform different agreements or proofs of legal bases required for data exchange interfaces separately.

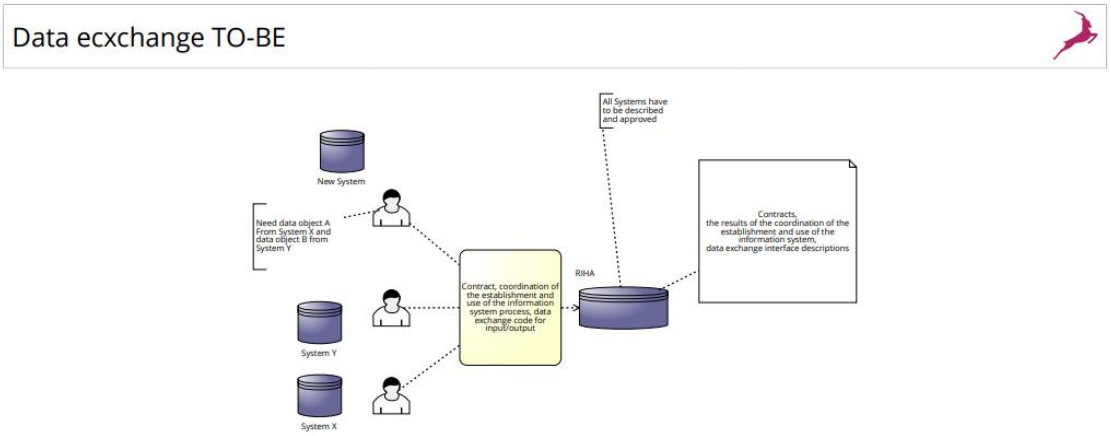


Figure 17. Relationships in the TO-BE process Signavio (compiled by the author).

# 5 Summary

This research analysed the duplicative activities of the processes involved in creating data exchange interfaces and identified bottlenecks where processes can be automated. Through this action, the time and financial cost of setting up data exchange interfaces will be reduced and will result in faster and more transparent cooperation, the implementation of interfaces and improved data exchange will also benefit citizens in particular.

The work mapped out existing processes and conducted surveys between different RIHA users. The result confirmed the existence of the problem. The activities of these processes need to be improved as a matter of urgency and the various activities needed to automate the processes are highly anticipated by users. Feedback confirming the existence of the problem also came through the polls. Shortcomings were identified regarding the purposeful use of the RIHA dataset, where the obligation to register and co-ordinate the establishment and use of the information system has been imposed, but the efficiency of all activities from this input to the data internalisers is minimal.

## 5.1 Research questions and summaries

- *What are today's best practices, key process activities and more positive results for the different stages of creating data interchange interfaces?*

The investigation revealed that practices are similar today and, as far as available, require a high degree of upgrading, improvement and automation. The smaller the institution, the harder it is to go through the process of registering the entire information system, obtaining approval, but this stage is a prerequisite for obtaining a data exchange interface. If the information system has not been registered or received approval, it is also not willing to realise the data exchange interfaces.

- *What are the bottlenecks and biggest problems in this process today, their causes and user experience?*

As part of the investigation, 13 of the 15 participants identified more significant bottlenecks for them today.

As a result, it can be pointed out that the biggest and most complex bottlenecks today are a number of aspects:

- ✓ RIHA approval process
- ✓ Communication with RIHA
- ✓ Finding the main database of necessary data fields for a new official in a given field
- ✓ Lack or lack of IT workforce
- ✓ Lack of development resources
- ✓ Obtaining documentation and concluding contracts for data exchange interfaces

- *What are the user's visions and visions for improving the creation of data exchange interfaces in the future?*

The investigation revealed that over the years, visualisations of different visions have been abandoned, justifying the situation for fear that so far RIHA-related processes have only become more complicated and bureaucracy has only been added.

The solutions proposed to the survey participants in the same research work seemed highly anticipated and signalled that if such a solution were implemented by RIHA, there would in part be fewer problems. Certainly, this vision does not solve the aspects outlined in connection with RIHA's communication and cooperation with regard to the future solution. But to a very large extent, it saves time and also financial resources in creating a data exchange interface.

- *How and where is the legal control of data queries today and the compilation of correct queries that meet the needs of data seekers, in the example of different organisations?*

The work revealed a specific feature where multiple legal checks for obtaining data exchange interfaces are closely related to the legal checks carried out upon the establishment of the information system. However, it appeared that RIHA's coordination may not be sufficient to have a legal basis for obtaining a data exchange interface. Some data administrators take into account RIHA approvals and other data administrators make a separate legal basis check and the approvals received upon registration of the information system may not be resolved as registered in RIHA, i.e. even if another national information system was marked as the main database of data in the data composition in RIHA, in reality the solution may not be the same. In this case, the situation arises where the RIHA co-ordinates – the data should start arriving through the data exchange interface from the main data repository of the new information system, but in connection with the refusal of the data exchange interface by the data administrator, the situation arises where the solution is realised through duplicate data entry.

The problem area of this point would be solved by the visual presented in the research, where more parties would be immediately involved in the RIHA coordination round and the agencies whose information systems are intended to retrieve data through queries would be immediately involved.

- *Is the vision offered as a result of research to automate processes for creating data exchange interfaces one of the points of interest for public sector organisations and individuals? How can the development phases of data exchange interfaces be automated???*

Among the respondents in the study, it emerged that of the 15 respondents, all agreed that the processes carried out at RIHA needed to be updated and expanded through better fungialities. One important prerequisite for automating the processes of creating a data exchange interface is to complement the RIHA coordination ring. By complementing the RIHA coordination ring process and automating the conclusion of contracts necessary for the creation of data exchange interfaces from there, it can also be made easier to assemble the queries necessary for data exchange interfaces via the automatic code generator. This would also result in a significant reduction in the resources required for development, which today is a particularly high problem for smaller local governments and managed institutions.

- *What are the possible solutions?*

As a result of the research, the following processes have been identified by respondents and need to be improved:

- ✓ Complementing the process of setting up the database in RIHA by instantly involving representatives of data management authorities in the coordination round.

- ✓ The management system of the data sets in the databases shall be supplemented in such a way that, in addition to uploading to the file, data can be managed one by one and data fields and descriptions can be searched without downloading the data set files. Additionally, the national primary database that is designated as the source of the specific field would be displayed.

- ✓ Complementing the process of coordinating the use of the database in the RIHA by immediately involving representatives of the data management authorities in the coordination round.

- ✓ To bring the conclusion of agreements/contracts for the necessary data exchange interfaces together in a single place where all information system-related management is carried out – to RIHA. Allow the parties directly to enter into a data exchange agreement in RIHA immediately after completing the coordination round within THE required fields.

- ✓ In order to reduce the development of the data exchange interface, create an automatic code generator which input – the output to the compliance would generate the corresponding code outputs for both the data manager's side and the person requesting the data query immediately, which can be transmitted to the information system developer for interviewing the information system.

- *How do I reduce the use of queries with redundant data? How do I speed up the creation of correct queries?*

The proposed solutions made as a result of all the research would be an indicator of not continuing the model that has become normal today, which offers excessively large data interchange interfaces in the absence of a development resource, or the development

remains on hold until a time and/or financial opportunity arises to carry out the necessary queries.

## 5.2 Additional problems to pay attention to

With regard to the results obtained through feedback from study participants, it can be summarised that:

- communication between the various parties RIHA – the round of coordinators – representative of the institution entering the information system would also need to be significantly improved.

- where automatic interfaces can be used for the exchange of necessary data, automation should be used with the possibility of human control.

- legal bottlenecks should not create additional work for smaller institutions, but should remove the relevant concerns in the regulations to ensure the successful use of the service for all institutions, both larger and smaller.

- The RIHA should be further developed in such a way that the use of this system would be beneficial for all, and not only for the partial supervision of the State. The use of RIHA should facilitate the management of data fields, the conclusion of contracts and cooperation for data exchange interfaces, the establishment of data exchange interfaces. At the moment, RIHA is seen as only a very large and unnecessary extra job.

## 5.3 Closing remarks.

This research has shown that it is very possible to automate and simplify the entire data exchange interface process with the help of different it tools. The signals received through survey feedback confirmed, in turn, that the problem exists and is very much expected to be resolved and that the whole process will be made better and more humane. The solutions proposed as a whole would deliver a very big time, workforce, as well as financial victory for data managers and data wishers alike.

And, of course, one important aspect here would also be the re-use of data, which would also facilitate the provision of e-services to a citizen who uses and consumes different services in our e-state in one way or another.

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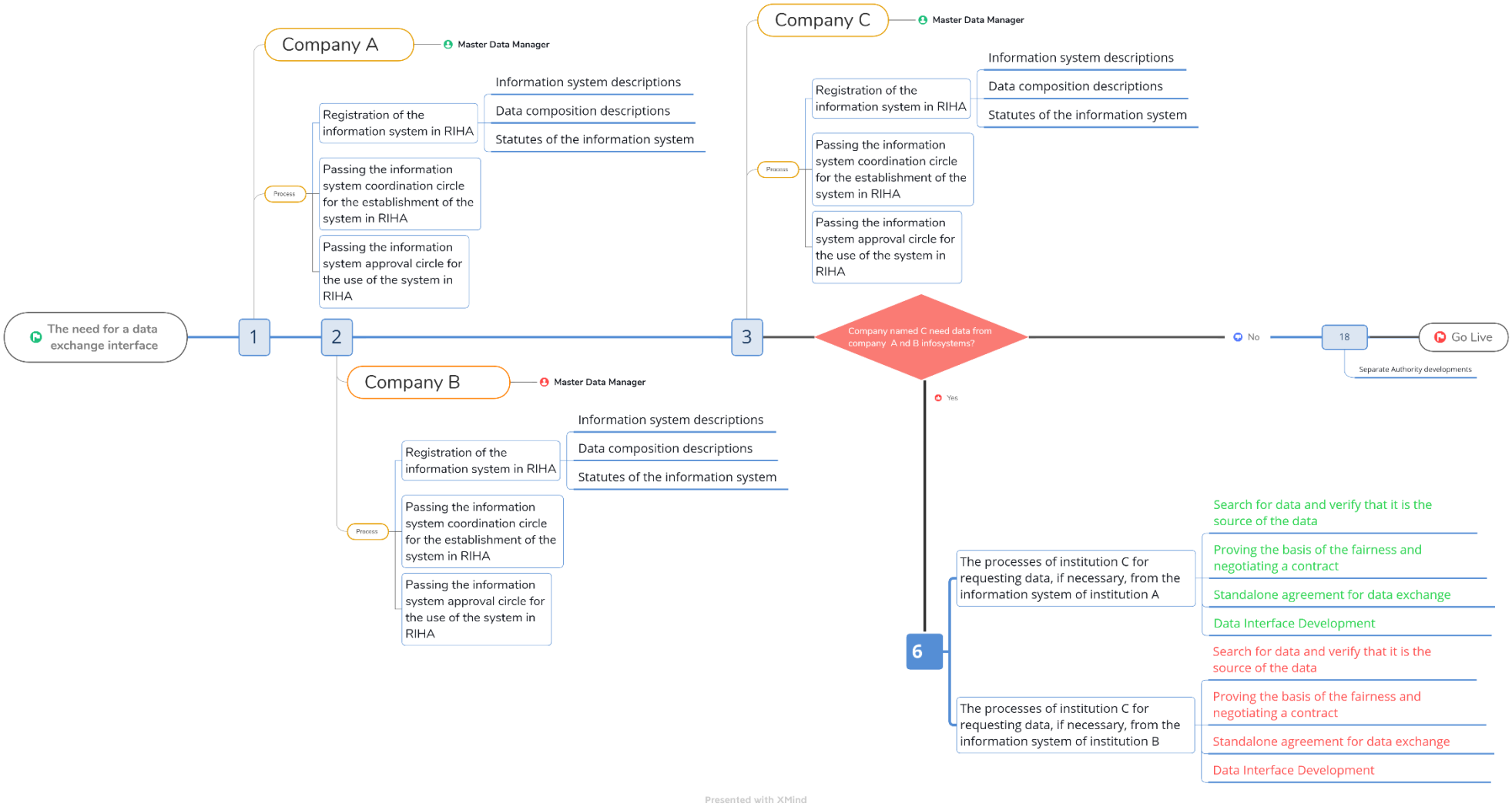
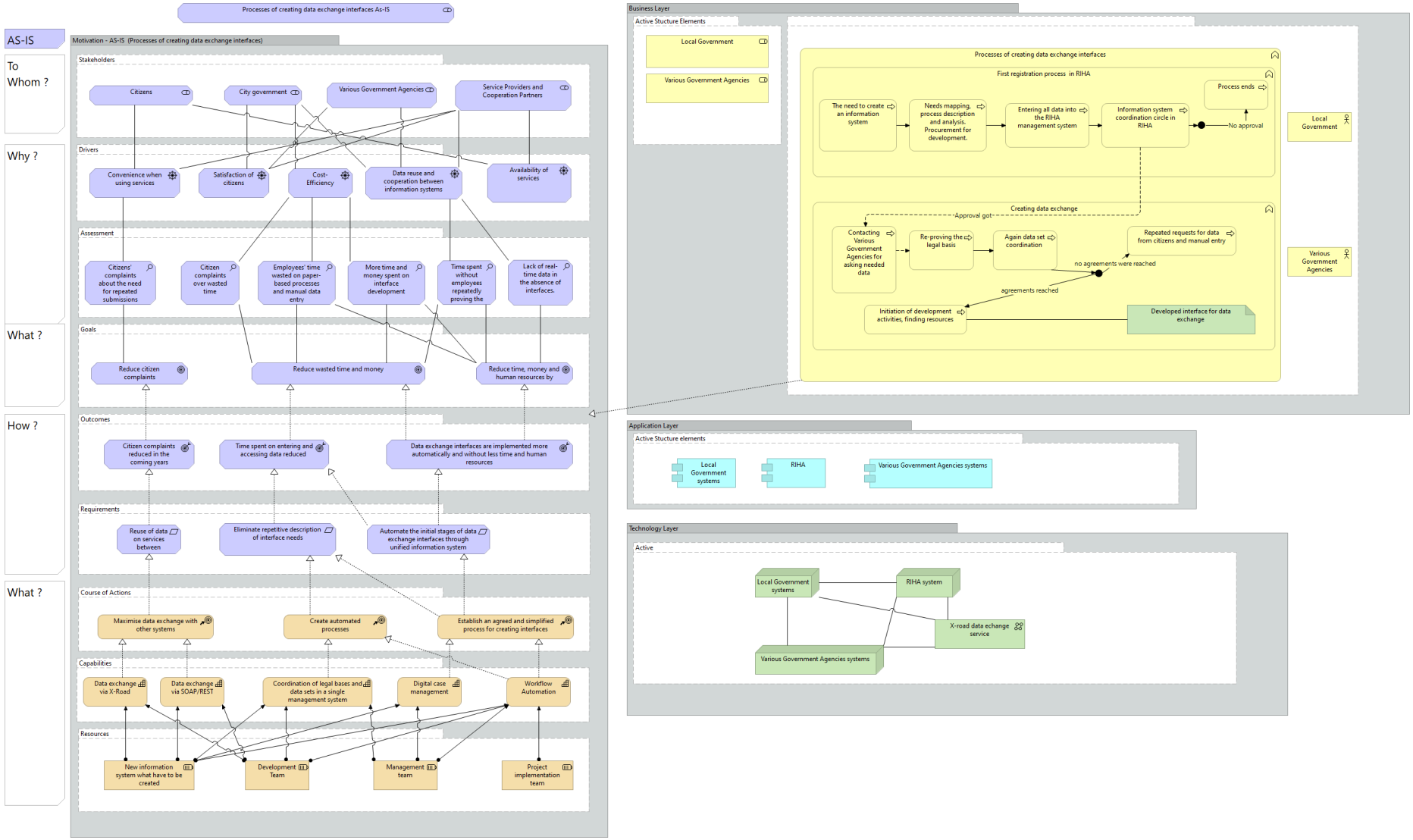
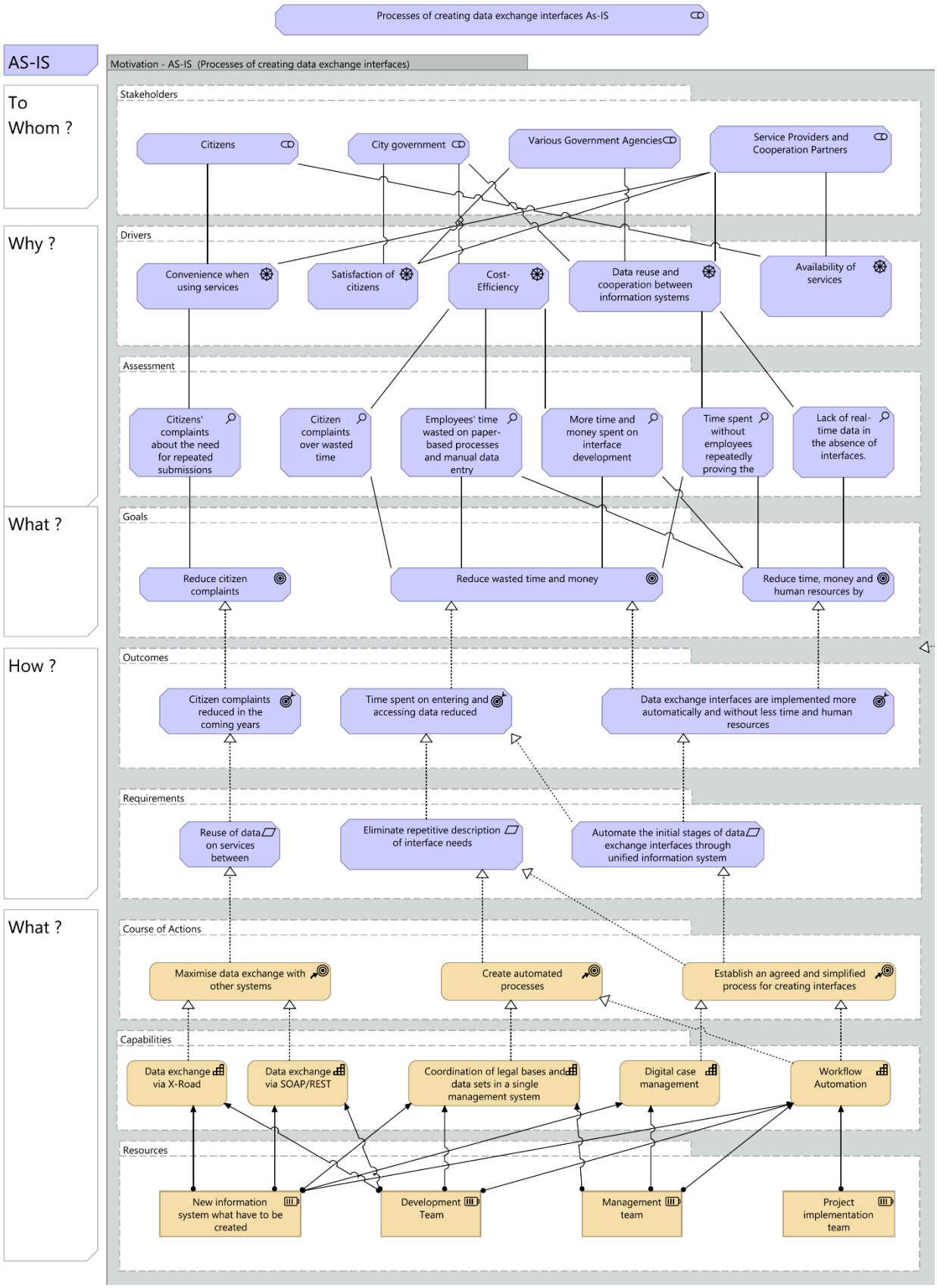
# Appendix 2 – Xmind process diagram with different institutional steps version 1 (Figure 1)



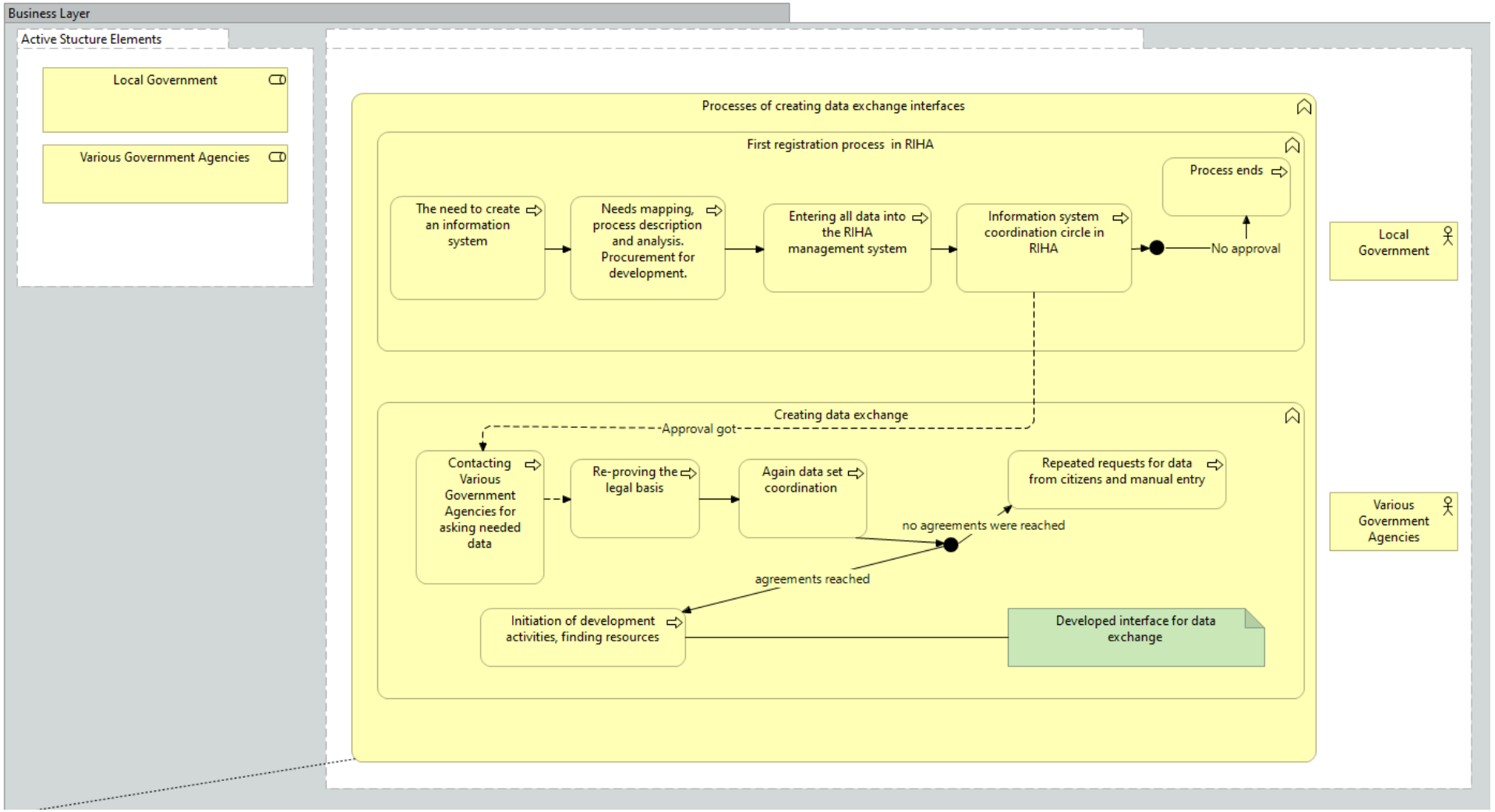
# Appendix 3 – AS-IS ArchiMate model view (Figure 2)



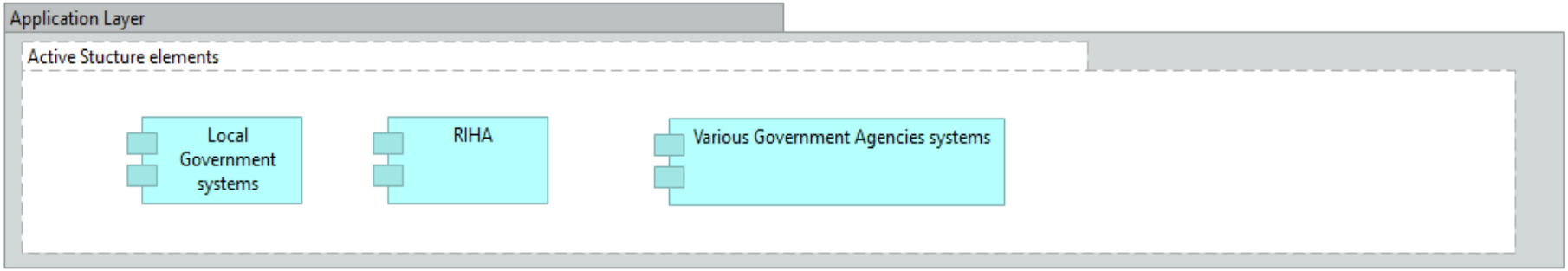
# Appendix 4 –AS-IS ArchiMate model view Motivation Layer(Figure 3)

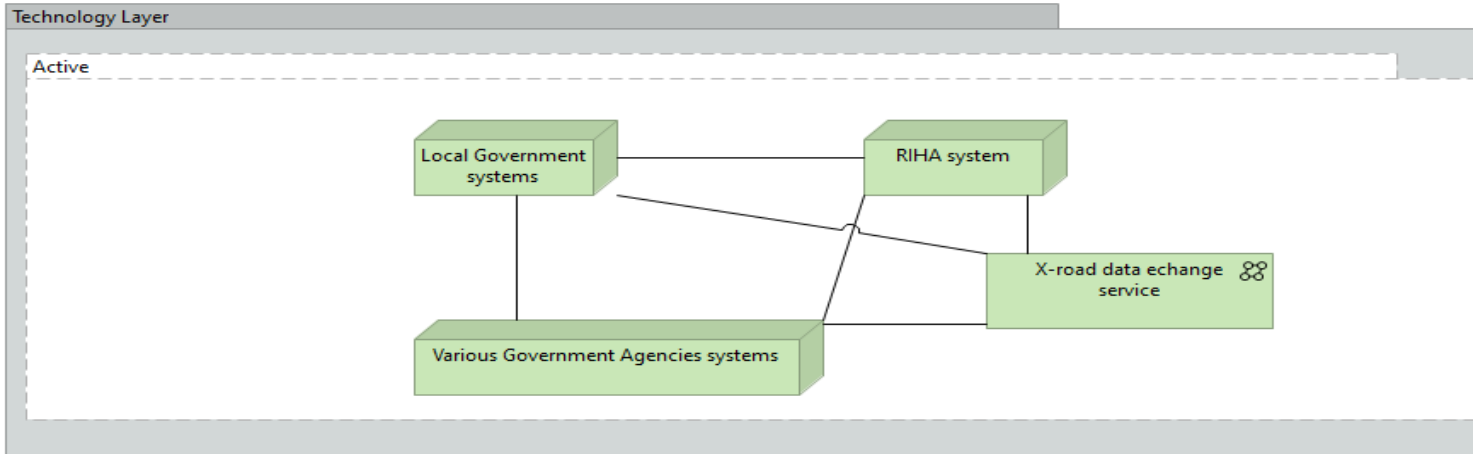


# Appendix 5 –AS-IS ArchiMate model view Business Layer (Figure 4)

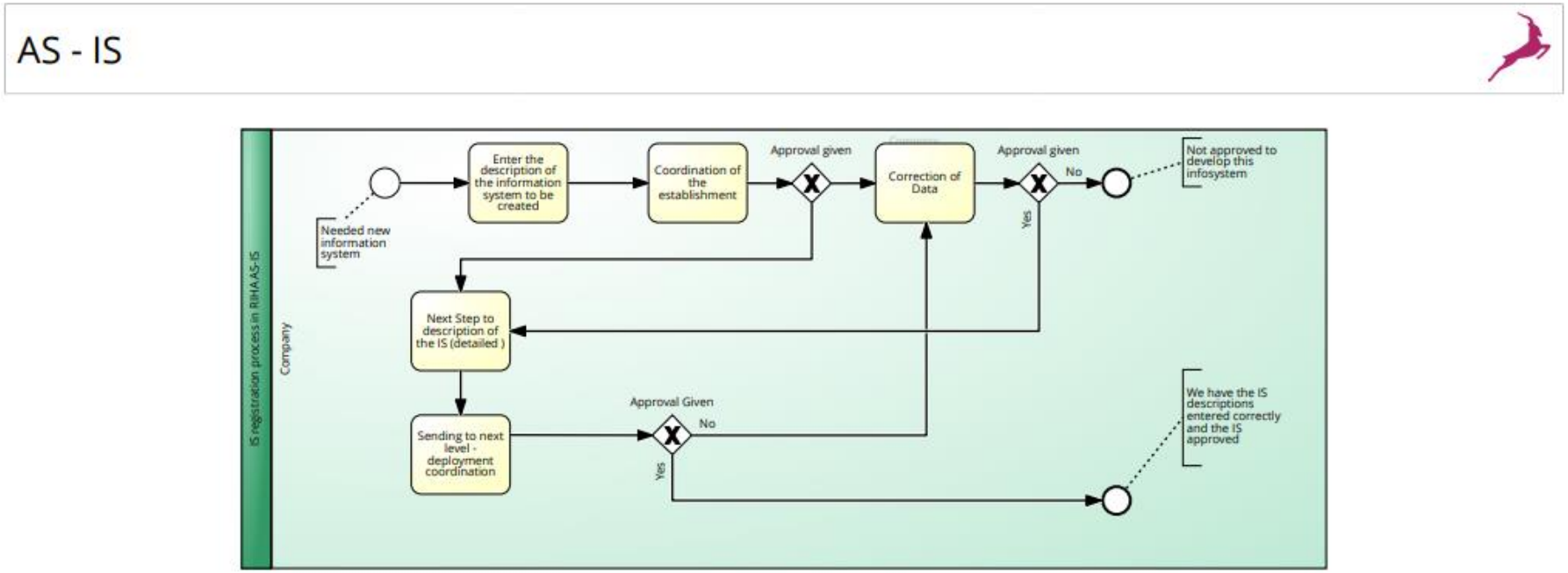


## Appendix 6 –AS-IS ArchiMate model view Application Layer (Figure 5) and AS-IS ArchiMate model view Technology Layer (Figure 6)

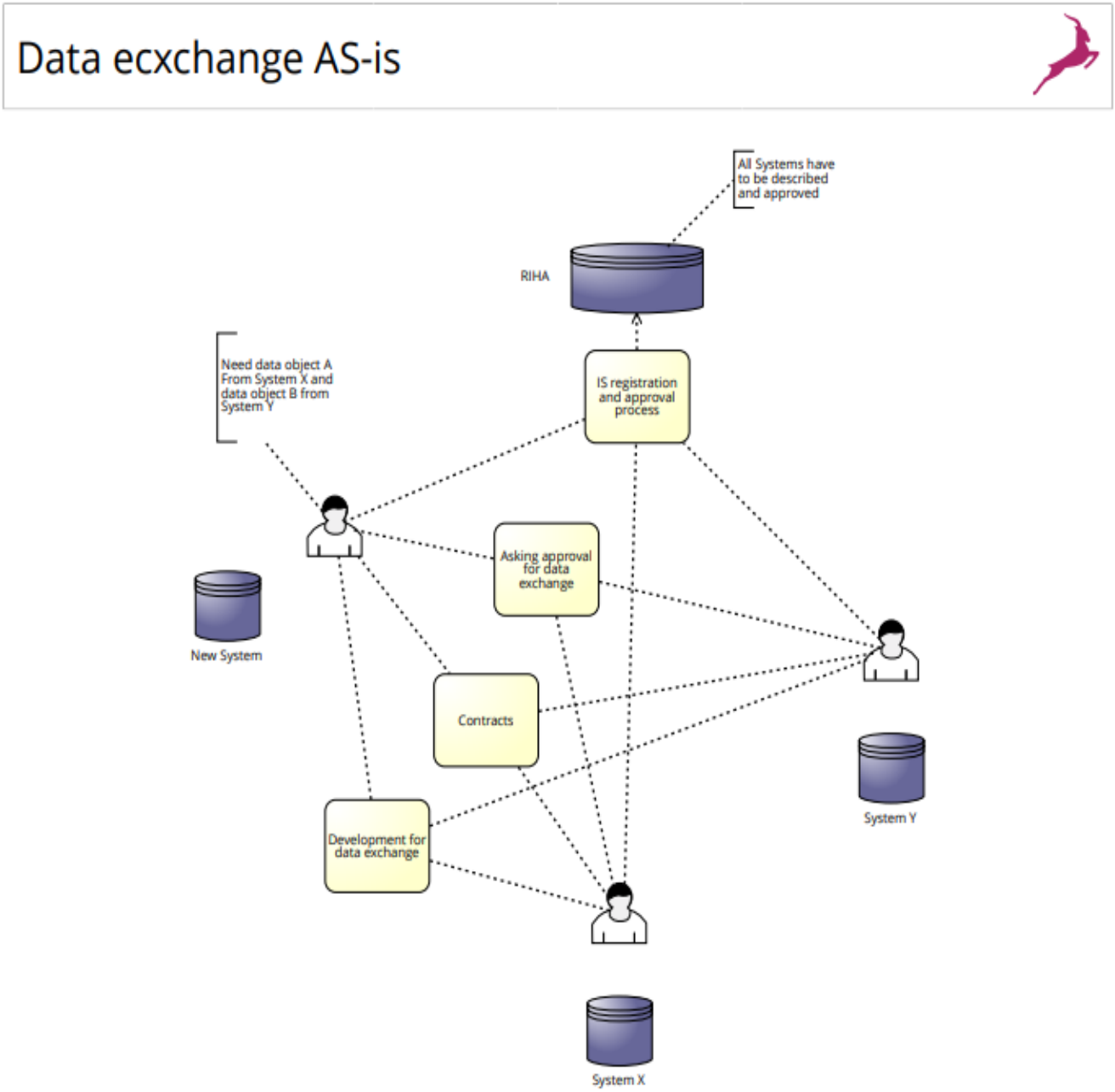


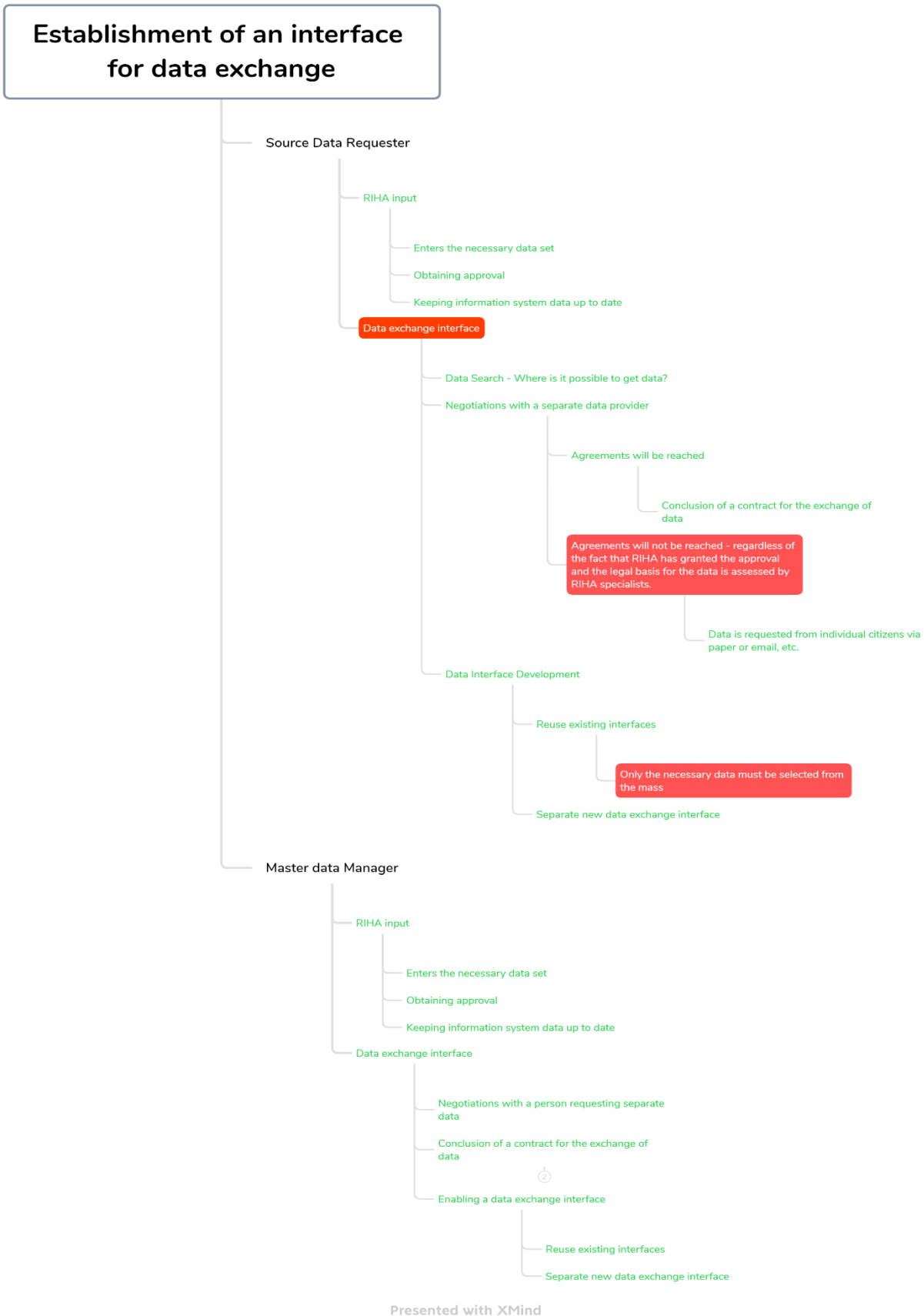
**Appendix 7 – AS-IS Signavio mapping for the registration and coordination of a single information system (Figure 7)**



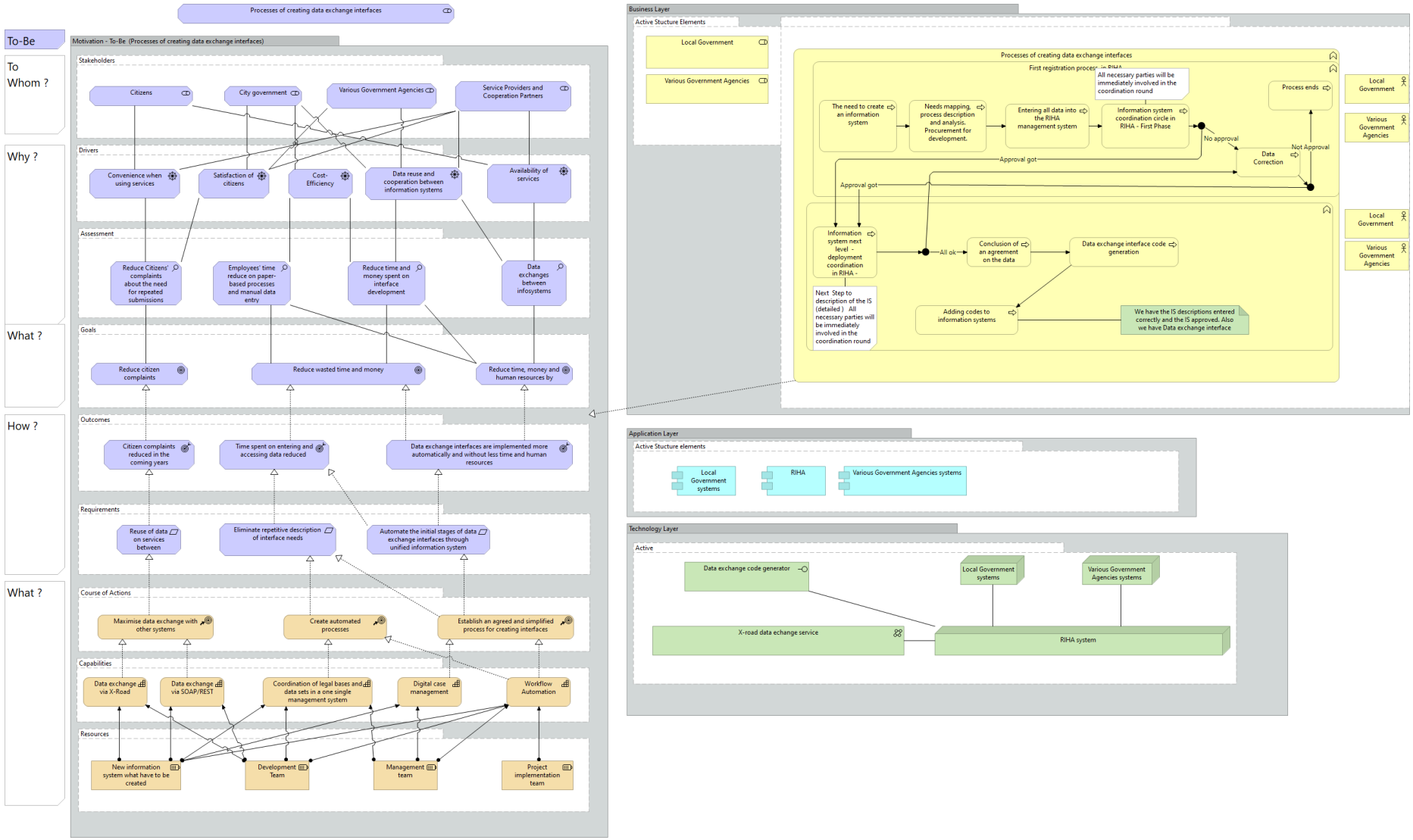
## Appendix 8 – AS-IS Signavio mapping for the registration and coordination of a single information system (Figure 8)



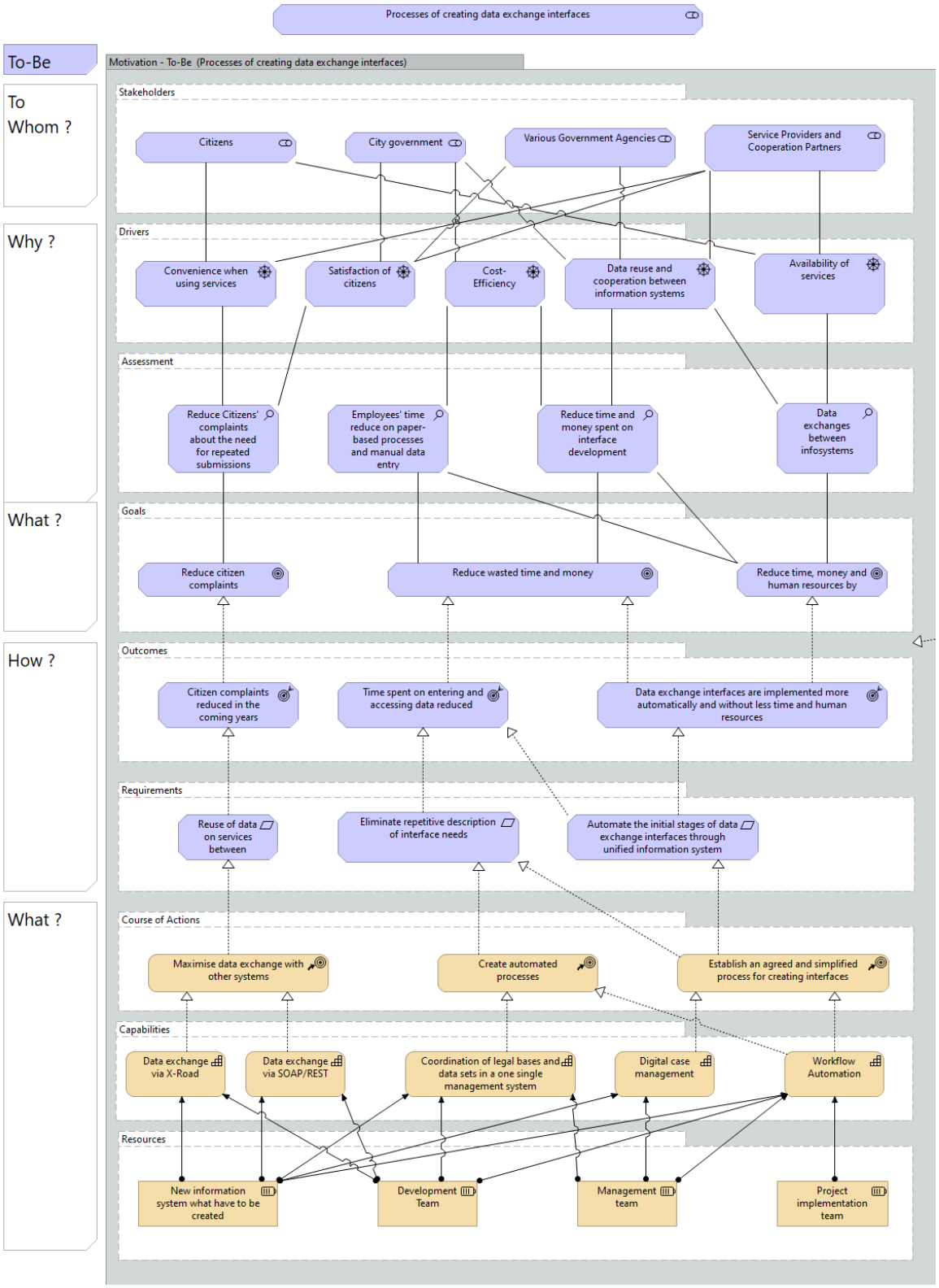
# Appendix 9 – Steps required for the Xmind AS-IS data exchange interface (Figure 9)



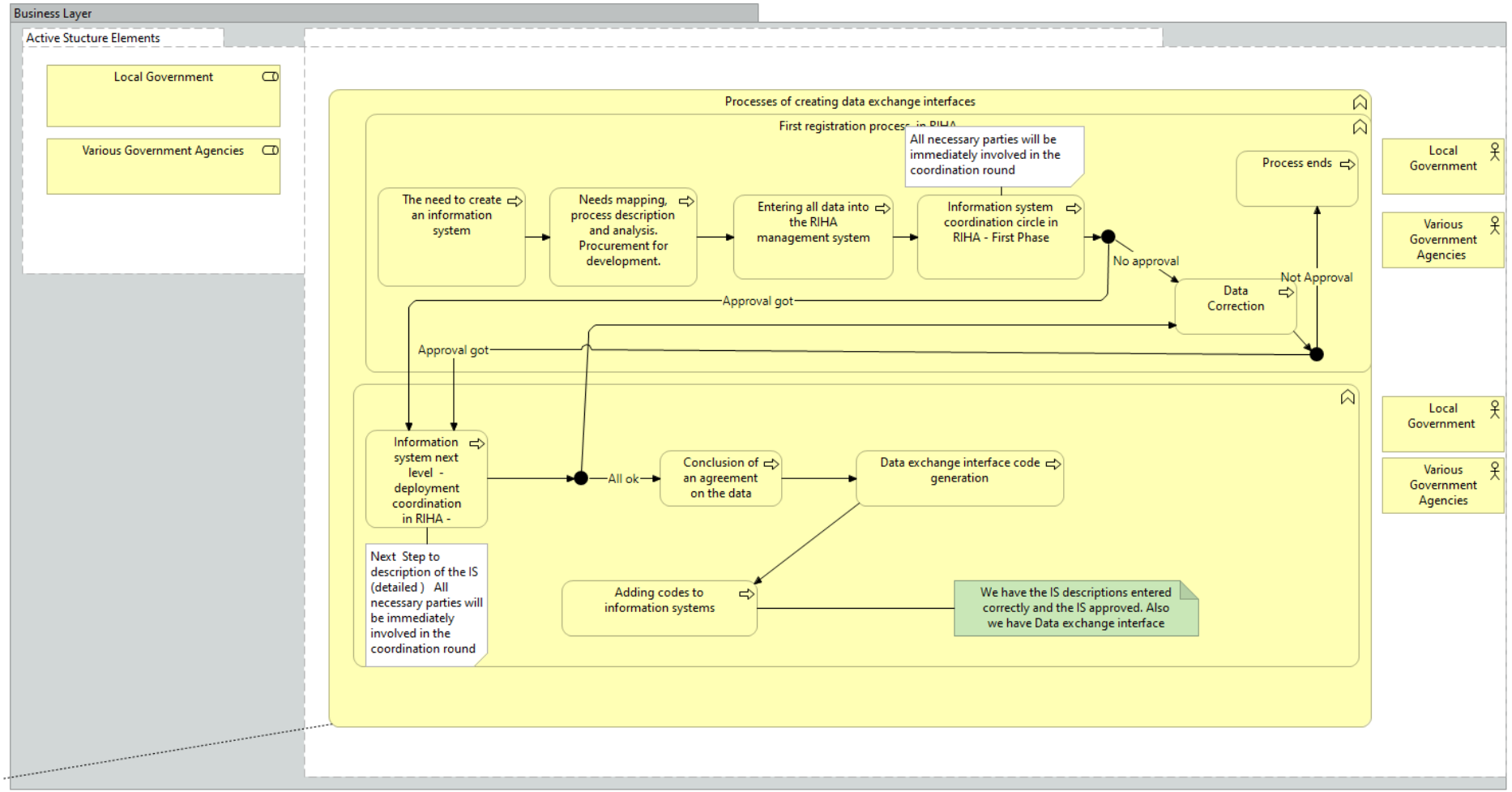
# Appendix 10 – TO-BE ArchiMate model view (Figure 10)



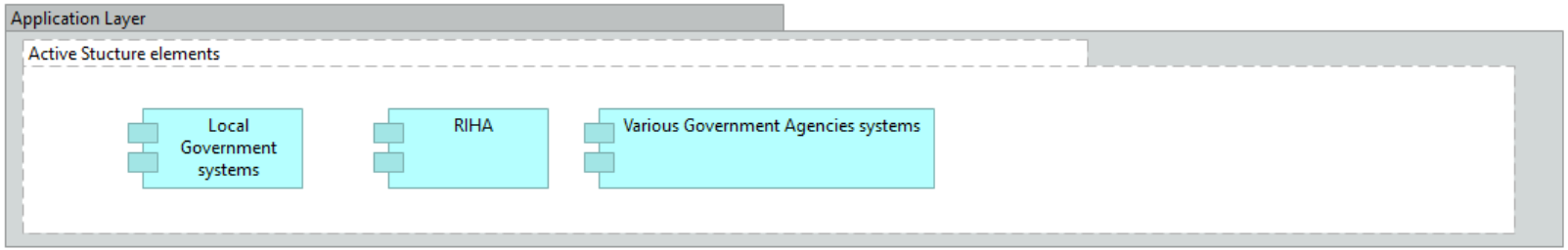
# Appendix 11 – TO-BE motivation Layer view – ArchiMate (Figure 11)

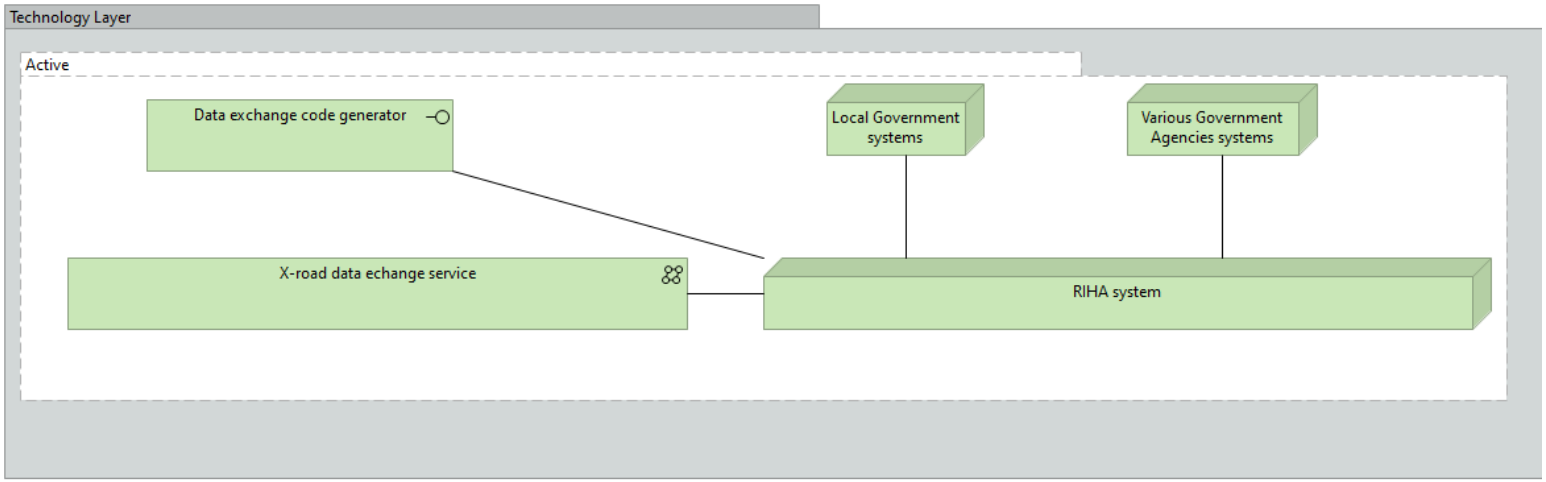


# Appendix 12 - TO-BE Business Layer View – ArchiMate (Figure 12)



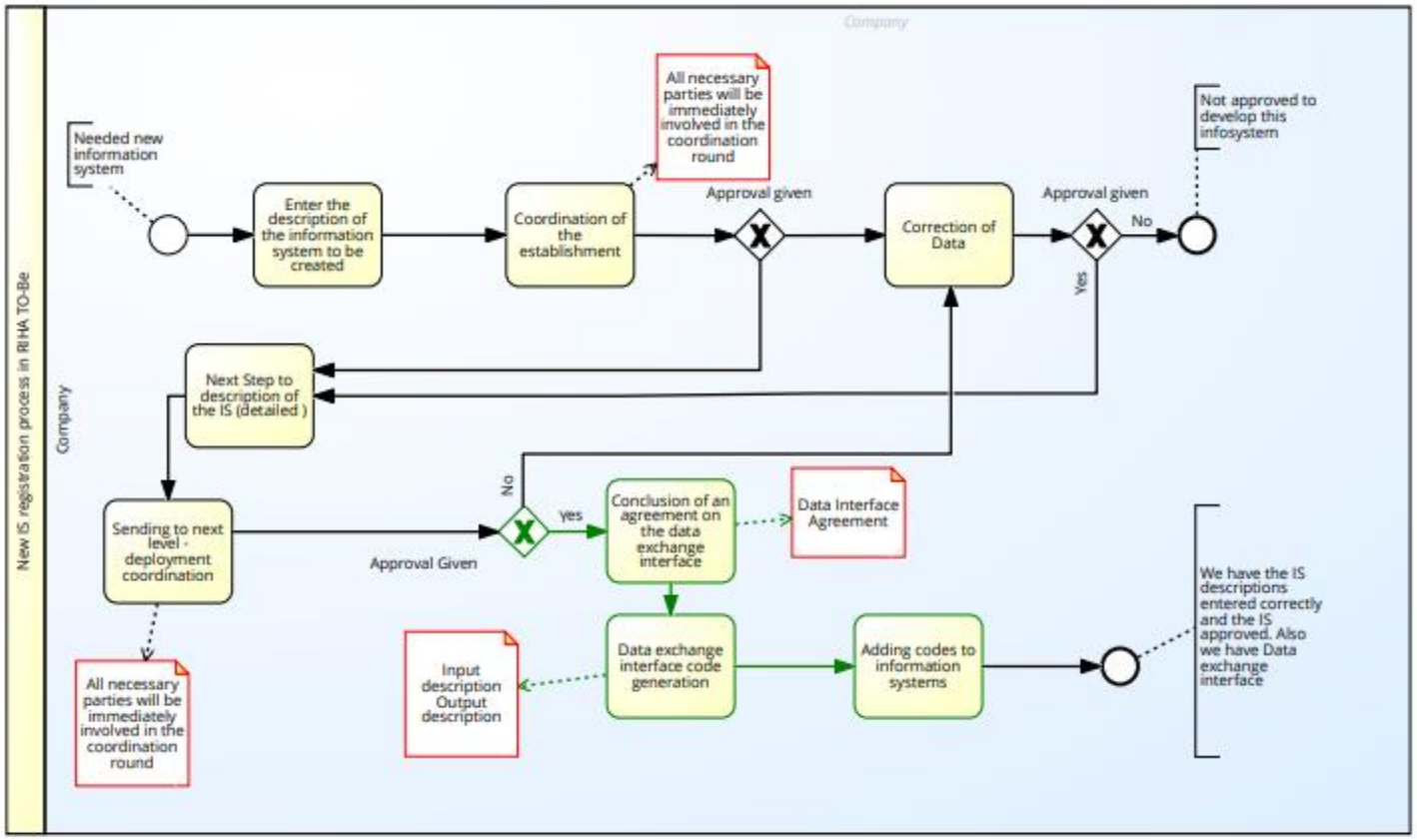
## Appendix 13 - TO-BE application Layer View – ArchiMate (Figure 13) and TO-BE Technology Layer View – ArchiMate (Figure 14)



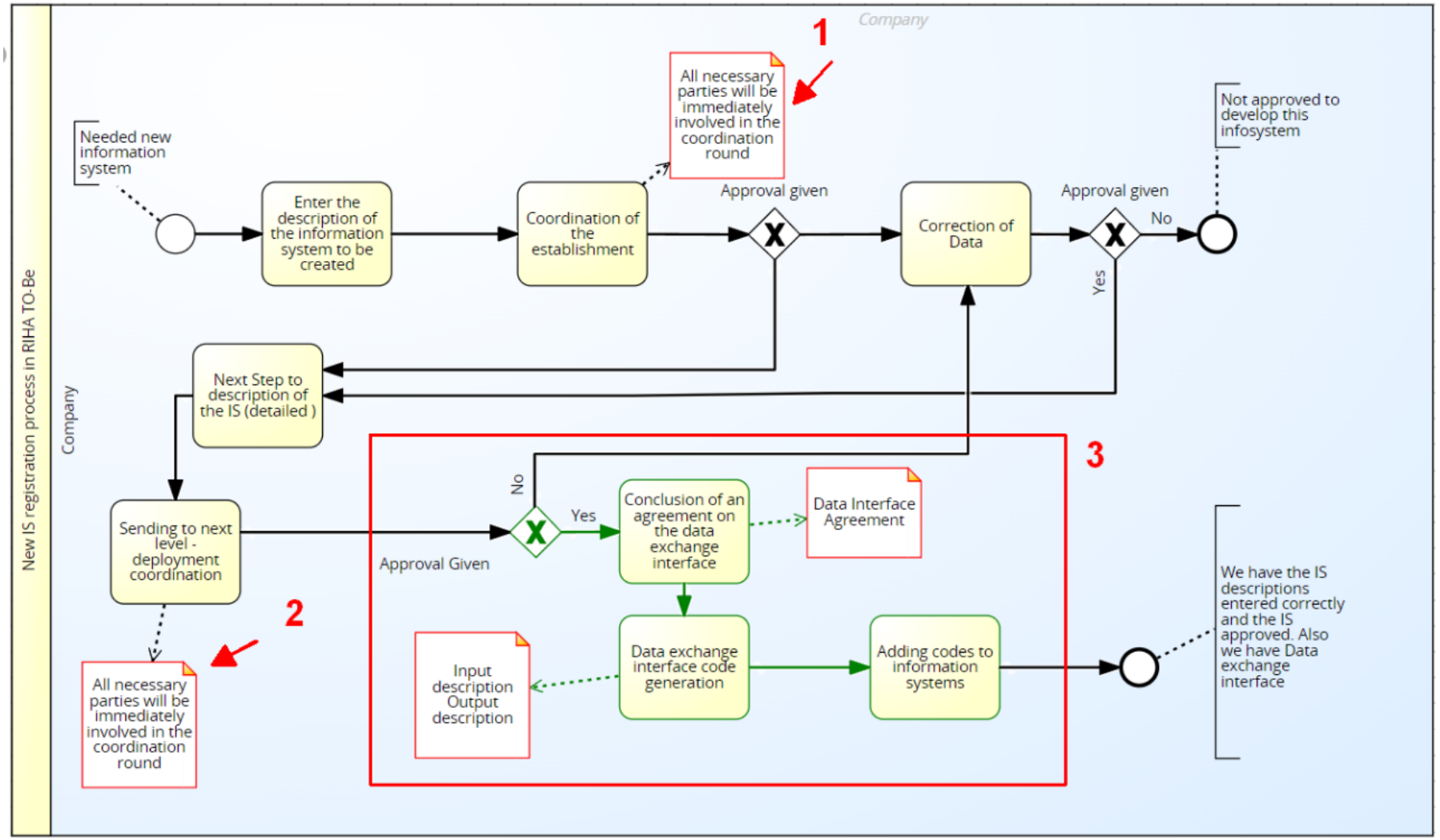



## Appendix 14 - TO-BE vision processes - Signavio (Figure 15)

To-Be



## Appendix 15 - TO-BE process Signavio - with differences compared to the AS-IS process (Figure 16)



## Appendix 16 - Relationships in the TO-BE process Signavio (Figure 16)