Preparing Public Agencies for Harnessing AI: A Study on Variables Shaping Multi Actor Information Infrastructures

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Abstract. While governments around the world are seeking to harness the power of artificial intelligence (AI), attaining high-quality information as input for training AI-models remains a major challenge. Policymakers looking to boost AI readiness in the public sector need high quality multi-actor Information infrastructures (MAIIs) to obtain high-quality information. It is unclear which fundamental decisions can be made to shape information-sharing infrastructures for governmental purposes, even though there is some literature on these infrastructures. The main goal of this paper is to identify key variables for shaping MAIIs. Drawing on literature, expert interviews and qualitative data analysis, this paper reveals multiple variables classified into three main categories: (1) information-sharing process, systems, and services, (2) information (format), and (3) governance structures. Findings indicate that considering these variables in an early stage is needed to maximise the benefits and limit the risk of failure in shaping an MAII.

Keywords: Information Sharing infrastructures · Multi Actor Information Infrastructure · Public-private Collaboration · Governmental Collaboration

1 Introduction

Public organisations require information for (automated) process handling and decision-making. In every step, planning, implementing, executing, and enforcing policies, government organisations require high-quality information to fulfil their public tasks. Public tasks such as tax collection or social benefit allocation are by design highly information driven. The quality of this information is especially important. It influences the decision-making and therefore affects the quality of the service delivery. Poor information quality can lead to inefficiency and economic losses [1]. Moreover, it leads incorrect decisions with a negative impact on the lives of citizens and entrepreneurs [2].

In addition to existing interest, information quality and the collection of complementary information sets has gained renewed importance. With technological developments such as AI, information has increased potential for a data-driven government. While governments around the world are seeking to harness the power of artificial intelligence (AI), attaining high-quality information as input for AI remains a major challenge. In

the real world, there are too few data sets available, the sets are biased, or the quality is too low [3]. "*Without good* data*, even the best machine learning algorithms cannot perform well*" ([3]. Where AI literature often focusses on the training and application of AI models on data, there is little focus on how to collect massive volumes of high quality [3].

Information collection and sharing is facilitated by information infrastructures (II) between two or multiple organisations. II's are also referred to as digital infrastructures or information-sharing infrastructures. These II's hold benefits for individuals, businesses, and society, but when these infrastructures fail, it can cause huge losses and problems.

We see at least three developments by which information infrastructures are becoming multi-actor information infrastructures (MAII). First, is the increased collaboration between governmental organisations. Reasons to collaborate can be efficiency, reusing information, and lowering the burden for the private sector. Second is the decentralisation of infrastructures. Traditional II's have changed drastically over time as "*Digitizing has the potential to remove the tight couplings between information types and their storage, transmission, and processing technologies—potentially shattering the dominant service model and the stability of the industrial organisation.*" ([4] p. 749). With decentralised services, intermediary organisations can provide parts of the information exchange process. Finally, there is an increased involvement of the private sector in providing II components. Not only public organisations are intermediates. Private organisations are increasingly involved in creating solutions for information supplying organisations. To help them align their business processes with the information supply chain to governmental organisations. However, not only the number of stakeholders evolves.

The speed at which the II technology is changing is enormous. As Tilson [4] already noticed in 2010: "*New combinations of services and capabilities can be produced at unprecedented speed.*" (p. 753). As such, IIs are shaped by decisions during their evolution, changing the configuration of the II in process, technical components, governance models and information formats. Essential variables in II's have a significant influence on the shape of the II. For example, choosing a private organised format or a create a custom government format will have a significant influence on the configuration of the II and on the roles and responsibilities of the actors in the II. Whereas non-essential variables have no direct influence on the shape of the II. For example, the market format specifically used is considered less critical and can be considered a lower-level non-essential variable. The essential variables can greatly impact the quality of the information exchange. Therefore, it is necessary to understand which are essential variables.

Sambasivan [5] showed that for AI, we need to look at the information exchange infrastructure and improve the data pipeline. It is important to know the process of obtaining information, as it can determine the [5]. A perspective on the information exchange from beginning to the end is therefore key. Information sets need to be made suitable for future AI applications during data gathering, ensuring enough high-quality information. It is important to know the configurations of the essential variables and the responsibilities of the involved governmental organisations. We create an overview of the essential variables shaping the MAII, to help organisations understanding multi-actor information infrastructure. This paper proceeds as follows. Section two shows the

levels of information-sharing infrastructures and several variables found from literature. Section three outlines the research approach, followed by section four, which presents the results of the interviews. In section five, we discuss the results and conclude in section six with the limitations and future research possibilities.

2 Categories of Variables Shaping Multi-actor II's

This research follows the definition of information infrastructure from Monteiro and Hanseth [6]. We perceive multi-actor II's in the scope of multiple technical components and social structures involved in the provision of information exchange.

The technical component includes a process of services, and systems and standards supporting this process. Additionally, information formats provide clarity for receivers and suppliers on the metadata. The social component includes the governance model between the actors involved in providing multi-actor II. The social and the technical component are highly interwoven, as agreements on the technical components are made between the actors of the MAII in a governance.

We can see MAII shaping variables falling in one of the three categories: 1) information and formats 2) process and technical components, and 3) governance. The first category entails variables on information. Multiple authors report on variables shaping information formats [7–11]. In these information formats, there are differences in complexity, openness, standardisation, and harmonisation with other information exchanges. Through these formats, it is possible to integrate data sets. This can contribute the amount of data needed for AI. Additionally, formatting and structuring data makes it easier to validate the information and increase the quality.

Secondly, literature provides several variables on the process and technical components. In terms of services, gateways and intermediating platforms in information exchange with the government are a hot topic [7, 12–15]. Other services mentioned are formatting or converting the information [16], time stamping [6], and trust services such as authentication, authorisation, and security [11–13, 17, 18]. These services are arranged in systems and a process, which can be designed central, semi-central, and decentral [10, 12, 15, 19]. Besides systems and services, we see papers focus on standardisation. Standards are the agreements or protocols specifying the use and connection of (multiple) systems [14]. It provides interoperability between technical components and helps organisations [18].

The third category are the governance variables. In an multi actor II a governance is required to align between different organisations. According to Kurnia [10] governance structures have to deal with information ownership, decision-making, and the control mechanism of the main decision. Governance can focus on lower administrative burden and leading to the re-use of information [20], but also "*ensure that conflicts are addressed, and that the necessary resources are properly allocated and utilised*" [21]. Several authors, mention different types of actors in the governances [16, 18, 20–22]. In a governance, multiple types of actors can be represented, such as information providers, intermediaries, software providers etc. [20]. Which can be both public and private.

Many papers focus on a single system or collaboration between two parties but lack the perspective from an entire II with multiple actors. Additionally, literature focusses

mostly on single variables, whereas there is a need for a higher-level list of the essential variables. This motivates us to research further the variables shaping a multi actor information-sharing infrastructure.

3   Research Approach: Expert Interviews and Qualitative Data Analysis

3.1   Overview of the Research Approach

Given the scarcity of research on essential variables of an entire II, it is necessary to collect insights from practice. We used literature as input to create a framework for the semi-structured interview format. This allows us to have a dialogue with the respondents during the interviews. The interview protocol (available on request) was used to conduct semi-structured interviews with experts. The semi-structured approach enables respondents to reflect on their own experiences allowing new insights to emerge [23, 24].

3.2   Sampling

Three criteria guided the selection of respondents for expert interviews. Primarily, the respondent must be involved in shaping a multi-actor II. Next, the respondent had to have more than five years of experience in an II, ensuring they have deep knowledge of the subject matter. The third criterion is that all respondents represented the government in the MAII, for information sharing from business to government in the Netherlands. There is a significant difference between personal information and business information in terms of II's. Our focus is on business information. Based on these criteria, we reached out to eighteen respondents. Seventeen respondents were open to an interview. We conducted a total of sixteen interviews with seventeen interviewees to discuss the essential variables shaping an II. An overview of the respondents is available on request.

3.3   Interview

We asked respondents to relate to their experiences with shaping II during the interview, which lasted sixty (60) to ninety (90) minutes. Additionally, we asked the respondents to reflect on the responsibilities of the actors in (shaping) an II and the context which can influence the decision-making. The interviews were audiotaped, transcribed, and sent to the respondent to be validated. Three of the seventeen respondents gave more details per email in response to the interview transcript. One respondent provided an additional meeting to elaborate more on the variables. To measure the saturation in the interviews we used of (semi) structured question formats to compare answers. Additionally, three people participated in the coding process, to ensure both the reliability as the saturation of the topics.

3.4 Analysis

Based on the three components of the interview protocol – information (formats), process and technical components, and governance – we created an overview of the answers given by respondents. The answers were compared across respondents, and multiple variables were recognised. Section four presents the resulting groups of answers. This is the first step of the data analysis process. Further research will focus on using quantitative coding techniques using Atlas.TI.

4 Interview Findings

The following sections present variables in three categories: process and systems, information, and governance.

4.1 Information

Table 1 presents eight essential variables mentioned by the experts for shaping information in the II. The format was noted as necessary to exchange information, as unstructured data is difficult to understand and process. The use of an information format is commonly mandatory. However, the first variable shows that multiple formats can be allowed.

Several respondents stated the wish to have one format, as eases the processing for the receiver organisations. Respondent nine noticed: *"if everyone would use the same format, a large part of the network would not be necessary. It simplifies, and if everyone would follow the same format, to exaggerate, you would not need the network. Organisation would be able to connect directly with the receiver"*. However, creating and managing a single format requires an investment of time and energy. Respondent eight pleaded for using multiple formats, as it leads to flexibility and freedom of choice in formats. This can result in a higher adoption of the information exchange infrastructure. Respondent nine noticed that if there are multiple formats, interoperability between the formats becomes important. This respondent continued: *"the power of service providers is they convert information formats."*

Table 1. Essential information format variables shaping an MAII.

#	Essential variable	Choices		
1	Number of information formats (from receivers' perspective)	*One*		*Multiple*
2	Type of information formats	*Semantic*	*Syntax*	*Technical*
3	Use of existing information formats	*Yes, Standardised*	*No, Custom*	*Both*

Table 1. (*continued*)

#	Essential variable	Choices		
4	Information format collaboration	*Collaboration*	*Individual*	*Both*
5	Designing information format by	*Public organisations*	*Private organisation*	*Both*
6	Roles involved in designing of information format	*Intermediate*	*Receiver*	*Third party*
7	Managing information format done by	*Public*	*Private*	*Both*
8	Roles involved in management of information format	*Intermediate*	*Receiver*	*Third party*

The second variable mentioned is the type of format used. In some cases, only the technical format is specified, such as the use of Edifact or XML. In other cases, syntactical and/or semantic rules are applied. This creates complexity and require alignment between actors in the MAII.

As a third variable, respondents mentioned formats can be reused from existing (market) formats or be created specifically for certain information exchange. Respondent nine stated "*For the formats and interfaces we decided to join what was already known to the market. (..) The choices were made to unburden the delivering parties as much as possible. (..) especially to limit the costs of market parties in their investments*". This can be done if the requirement to the format aligns with existing formats. However, if this is not the case concessions need to be made on the requirements to the format.

The fourth essential variable is in the design of information format. Respondents notice how a single organisation can establish the information format, yet it is also possible collaboration is sought out between the actors in the II, or even with other information exchange processes. Involving multiple organisations can improve the quality of the information format. It can also improve the interoperability of the data between organisation and encourage public organisations to reuse provided information sets. This lowers the administrative burden for information supplying organisations. Collaboration can have many positive effects, yet creating a single format is complex in a multi-actor environment. This format must include all requirements and must be agreed upon by all actors. This may have the consequence that receiving organisation lack control over the design of the format.

The final four variables, variables five to eight, involve the actors concerned in designing and managing the format. The design and management can be done by public and/or private organisations, on a national or international level. There are different types of actors which can be involved in designing or managing the format, such as intermediaries, suppliers, receivers, or third parties.

So overall we have seen eight variables which all are connected to each other. There is not one way to organise the information format, this means there can be many configurations of information formats.

4.2 Process, Systems and Standards

Table 2. Process & systems variables shaping an II.

#	Variable	Choices			
9	Services available in process (multiple possible)	*Information submission service, providing an address book, identification and authentication, supporting the information delivery process, ensuring, or validating information quality, information formatting, information transformation, providing support, suppling track & trace of messages, safety & security, and securing / storing and archiving information as well as meta-data, encryption, user friendliness*			
10	Organisation of the II	*Central*	*Semi central*	*Decentral*	*Hybrid*
11	Use of existing systems	*No, Custom*	*Yes*	*Combination*	
12	Collaboration in the II	*Individual*	*Collective (private)*	*Collective (public)*	*Collective (both)*
13	Use of existing (open) standards	*No, Custom*	*Yes*	*Combination*	
14	Multiple standards permitted	*Yes*		*No*	
15	Involved in providing (technical) components	*Sender*	*Intermediate*	*Receiver*	*Third-party*
16	Involved in providing (technical) components	*Public*	*Private*	*Both*	*None*

When it comes to process and technical components, the interviews with the respondents lead to eight essential variables shaping an II. These variables are presented in Table 2.

The most mentioned and ninth essential variable is the presence of certain services in the information exchange process. Next to the provided services in the literature, the respondents added several to this list. As respondent eleven stated: "*we build services in a modular way, giving us flexibility. We started with a receiving and delivery service,*

authorisation service, and a validation service. With the increasing number of message types, we added assurance, attachments, and signatures of the accountant. It is easy to incorporate new services." The respondents made it made clear that these services are not static, and the available services can (and will) change over time. Each of the services can be provided by one or more organisations in the II.

The tenth variable addresses the organisation of the II. If there are multiple systems providing services in the II, this can be arranged central or decentral. Several respondents noticed that there is a scale between completely central and decentral. In some cases, it might be possible to have both a central and decentralised way of information exchange, which would result in a hybrid form. These choices depend on, for example, the existence of ready-to-use systems and the presence of private sector systems.

As the eleventh variable, respondents noticed how existing systems can be (re)used. For example, respondent thirteen stated that designers of an II often leave a submitting part of the process to the market to reuse existing systems. This choice depends on context variables such as availability of systems and the technological advancement of existing systems. Reusing systems can be beneficial in efficiency, yet the existing systems must comply with the requirements to the II to be usable. Not all are convinced on reusing systems. Respondent three stated: "*I believe sometimes we look too much to what is already there and how it can be reused. We take too often the perspective of what it is now, while sometimes one needs to look at it from scratch. How would you like the II to be*."

As a twelfth variable, respondents noticed collaboration is often sought in II's, not only with the private sector but also between public organisations. For efficiency reasons, many public organisations collaborate in the II to harmonise their information exchange processes. Respondents referred to the GDI (general digital infrastructure) in the Netherlands. This exist out of multiple technical components used by many public organisations to arrange the information exchange. Respondent four stated: "*Harmonisation would benefit the world, and not only the Netherlands. Each country has different data sets, definitions, and systems, whereas private organisations often operate internationally. Managing each II separately cost both governments, but mostly the private sector lots of money.*" Not all respondents plead for collaboration. Respondent three noticed how a clear responsibility is missing in many collaborations, which can result in failing MAII's. More actors are involved bringing their own (clashing) goals and values.

The thirteenth and fourteenth variable, are the use of one or multiple (existing) standards. Using (open) standards can benefit interoperability and decrease the chances of a vendor-lock in. Using multiple standards can lead to flexibility, yet also increases the complexity in the systems. It requires more maintenance of both the systems and the standards. In many cases standards are maintained outside of the organisation, again leading to lower control on the development of the standard.

The last two variables in the category of process and systems are the actors involved in providing de technical components in the II. Respondent eight noticed that some ministries have a vision of taking on the lead on how to arrange the II and even take on the role of creating parts of the II. Other ministries are looking more at solutions organised by the private sector. These latter government organisations see their role as setting guidelines and a framework for information sharing, but not implementing

the systems themselves. Services can be provided by information suppling or receiving organisations, intermediaries or even third parties. Leaving the provision of technical components to the private sector can have the effect that the government lose control over the shape of the II. This is why governance become increasingly important.

4.3 Governance

Table 3. Governance model variables shaping an II.

#	Variable	Choices			
17	Involved organisations in Governance	*Public*	*Private*		*Both*
18	Involved actors in Governance (multiple)	*Supplier, Receiver, Intermediate (public or private), regulator, support, control*			
19	Distribution of governance responsibilities	*Distributed (many)*		*Concentrated (one)*	
20	Structure of the governance	*Hierarchical*	*Hybrid*		*Heterarchical*
21	Responsibility of governance	*Process*	*Format*	*Technical components*	*Combination*
22	Scoped by	*Law & regulation*	*Public organisations*	*Private organisations*	*Combination*
23	Decision-making structure in Governance	*Consensus based collaboration*	*Majority rule*	*Power of perseverance by one (or few)*	
24	Governance funding	*Central funding*		*Pay for participation*	

During the interviews, respondents noted that governance is an important part of an II. There are eight essential variables mentioned by the respondents in shaping the governance of an II. These variables are presented in Table 3.

The first governance variables, 17 and 18, concern the actors involved in the governance. These can be both public and private, but also have different roles within the II. It often depends on the scope of the governance. Besides the directly involved organisations, governances can also include actors such as policy makers or supporting organisations. Most of the time they do not provide technical components but are involved when it comes to decision-making.

In designing the governance structure, the governmental variable nineteen shows it is possible to have a concentrated and a distributed governance. This depends on

the number of governance structures and the scope of the governance. Over time new governance structures can be created and be removed depending on the needs. Respondent five noticed how the number of governance structures can increase the complexity. Especially in terms of decision-making and funding. By having a concentrated governance, the number of actors involved can be higher, making it harder to align. However, a decentralised organised governance can become fuzzy decision-making and result in unclear definitions of responsibilities. The number of governance structures seems to be related to the scope of the governance, the participants in the governance, and the type of governance.

The type of governance structure concerns the relationship between multiple governances. If there are multiple governances, these often form a network of agreements and collaborations. Respondents notice how these governances can be hierarchical, with a higher-level authority and lower-level agreements within that framework. It is also noted that governances can be independent and have a heterarchical relationship.

When a governance is created, it often revolves around a topic in the II. Governance refers to decision-making and communication structures in which agreements are made on topics of process, systems, standards, information (formats), and the approach to governance itself. These are defined as the responsibilities of the governance.

As variable twenty-two shows, the scope can be defined by the original founder of a governance, both public and private, or be defined by law and regulations. The government implements some of the governance structures, others already exist in the market where governments can participate. In other governances' law and regulation define the scope of an II and its governance. Often (inter)national laws and regulations determine the II's functionalities. Respondent fourteen noted; "*There was limited choice for the stakeholders to choose from as there was an EU guideline which needed to be implemented*". Additionally, respondent thirteen stated "*we have a lot of freedom to create our own governance, however there is a European committee who influences the content of the governance.*"

Variable twenty-three shows there are multiple ways in which decision-making can take place in a governance. In the governance consensus can be sought out, there can be a majority rule, or there is power of perseverance by one or several organisations. As respondent thirteen stated "*On the public side you try to have consensus. It becomes difficult if one of the participating organisations does not want something. It is not the case that the majority rules. In practice it helps if governmental organisations understand each other's interest, and understand they work together on something. Sometimes conflicting interest can be changed by looking at different way of financing decisions.*" Due to this consensus-based decisions making, communication is important. In other II, governmental organisations do not make the final decisions. For agreements organisations need to lobby and negotiate. This means less control and more uncertainty over the outcome.

The last variable expert interview provided is the funding of the governance. In some II's, governance organisation involved pay contributions for participation, it is possible there are organisations that voluntary make a larger contribution. This can be deliberate to increase adoption by smaller organisations but can also be to increase their influence in the decision-making process. As respondent nine noticed, the downside from payment

for participation is that it is difficult to amerce organisations that do not comply with decisions made. If they do not pay and contribute to governance, governance does not exist anymore.

Additionally, it takes resources to ensure payment of the contribution fees. In these cases, central funding would be more convenient. Still, imbalance of the decision-making can be the result.

4.4   Context

As read in earlier chapters, many variables also are dependent on the context in which the II is shaped. The interviews revealed four types of context factors, which the respondents mentioned as important factors influencing the shape of the MAII.

First, the law and regulation can influence the decision-making in shaping an II. International and national limitations can limit the decision-making space. Additionally, regulations like the GDPR can restrict information collection.

The second contextual factor involves the context of the necessary information for the receiver. This includes details on the complexity of a case, if the information is used as the core business by the receiving organisation, and the message type.

The third contextual factor is the interest in the information by the actors. Respondent mentioned that political attention or political sensitivity can often restrain the freedom in shaping an MAII. Also, the interest from other organisations, for example the private sector can affect the process trough for example lobbying.

The final context factor is the availability and characteristics of the organisations. The decision-making space can be limited depending on the size, incentives, and number of organisations. Larger size organisations often have more resources available to influence the shape of the MAII. In case there is a governance, large organisations tend to have more resources to participate in the governance and develop technical components custom to their organisation. Therefore, small organisations can have lower power of perseverance and have to settle more to sub optimal outcomes.

5   Discussion

This research started with the objective of finding essential variables for shaping multi-actor information infrastructures. This research showed there are at least 24 variables. During the collection of variables two major insights were noticed. First, we observed many relationships between the variables. We expect in data sharing cases to find repeated clustering of variables. We expert cluster of variables will form into noticeable configurations. The second observation is the increased importance of governance over time. With multiple actors and changing configurations of MAIIs, we expect that the role of the governmental organisations will change. In the following paragraphs we will elaborate on these two observations.

5.1   Interaction Between the Essential Variables Leading to Configurations

During the interviews respondents noted the interdependence between the variables. Choosing one variable influences the decision-making space for other variables. It is

therefore important to organize the technical components, the information format, and the governance in coherence. One cluster of variables often noted by the respondents is the choice of using market systems and the more decentralised infrastructure. Decentralised and (semi) centralised infrastructures have the opportunity of service provision by intermediating organisations, leaving a different role for the government. Decentralised infrastructures benefit from the use of standards and more structured governances. Especially the concept of interoperability is important with decentralisation. In decentralised MAII's we expect more open governances, often scoped by private organisations, with a pay for participation. Private intermediate can have a business case to provide services for information suppliers or collaborate with public organisations to create state-of-the-art technology for public organisations.

Another typical MAII configuration of essential variables, is the one where public receiving organisation collaborate, and use public standards and systems. Here public intermediates provide services for the receiving organisations in terms of systems, standards, formats or governances. In these configurations there are well defined governances, in which governmental organisations make concessions on the requirements of the MAII. These MAII's tend to be scoped by either law or public interest. More often the funding is centrally organised, ensuring smaller organisations to be able to participate as well. Instead of custom solutions, other values are more important in these MAII's. Governments tend to reuse existing governmental systems for efficiency. This does lead to suboptimal configurations for each individual governmental organisation but provides a single point of contact for data suppliers to the government. It's focused on centralizing governmental data collection by having public intermediates unburden and support receiving organisations. Yet it requires a lot of alignment between the different governmental organisations.

The success of these configurations may depend on the context variables. Context variables can limit and alter the decision-making space. For example, rule and regulation may prevent organisations from collaborating with, or outsourcing to, private organisations. Additionally, power structures can alter the decision-making process. Large size organisations, with high interest and available resources, can put their mark of the collaboration. By lobbying for formats and standards, they can ensure that their requirements are met. On the other hand, low interest from the private sector, often due to lacking business case, limits the change of having successful (privatized) decentralisation. With too few private organisations providing a technical component, public agencies risk a vendor lock-in. Even though this research provided the first insight into the variables and the context, more research is needed to these configurations and the influence of context variables.

5.2 The Role and Responsibilities of Governmental Organisations

The second observation noticed is the changing role of governmental organisations in MAII. When shaping the MAII, governmental organisations can to some extent choose which responsibilities they take one and which they distribute to other organisations. Choosing responsibilities relates to the influence they have in the II. Some information exchange processes are essential for governments. In this case governments maintain the influence and responsibilities close to them. This often means central government

systems, government managed formats, and governance with only governmental organisations. Standardisation and collaboration can be sought, yet different requirements between different organisations will call for consensus and alignment.

Yet not all processes can be controlled by the government. Many information exchange processes are part of a larger data ecosystem. In some cases, the information exchange towards the government is only a small part of a larger exchange outside of the government. These types of II's are often with market standards, provided for a large part by the private sector and are more decentralised. Governments in these types of II's tend to focus more on aligning with the private sector. The responsibility for governmental organisations is more framework-setting and participating in (open) governances. Here governments can fulfil roles such as policy setting, advocating certain standards, and provide solutions to connect to market systems. However, there are little to no enforced government formats or systems. A risk of these types of governances is that it can lead to no assigned responsibility to a single organisation. If there is little to no interest, the development of the MAII might not lead to the expected or desired outcome. On the other hand, with too much interest by many parties, contradicting values and perspectives can result in sub optimal outcomes and even disintegrating collaboration.

Both type of configuration requires different roles from governmental organisations. Changing the MAII will require an understanding that the governmental organisations need to change along with the MAII. Setting course to more privatized decentralisation will need regulators and technical experts involved in guiding standards instead of setting them. More collaboration with both public and private organisations will require practitioners who can compromise and align technical processes. A change in the MAII does not only a change higher-level, but eventually also have its influence on the entire governmental organisation.

6   Conclusions, Limitations, and Further Research

Governmental organisations need high quality information to harness the power of artificial intelligence (AI), (automated) process handling and decision-making. Not only do they need high quality, but the amount of data necessary is high. Therefore, more information sharing, or data integration will be necessary. New MAII's will be constructed and existing II's need to be altered to match the future needs of governmental organisations. Yet, many public organisations struggle with (re)shaping their information-sharing infrastructures. Existing research lacks an overview of these variables for shaping MAII. We lack empirically grounded theories that can guide the design of IIs in a multi-actor context. This paper provides a first insight into the diversity of the variables, which can be used in further research to compare configurations of different IIs. Furthermore, they can be used for reshaping and governing IIs.

This research has three main limitations. First is the geographic limitation: the experts consulted in the interviews are from the Netherlands and provide insights from the Dutch context. Research should be expanded to foreign II's and international IIs. The second limitation is the small number of interviews (a total of seventeen). Even though we found saturation (i.e., requiring observations, ideas, and examples), more variables might be present. Further research can focus on validation and extension of these presented variables. The third limitation is that even though some correlations were mentioned in the interviews, we have not measured the relationship between the variables. We believe there are more interdependencies between the variables to be found. More research needs to be done to say something about the dependencies between the variables (and the context). As stated in the discussion we expect domination configurations of essential variables. Further research can focus on these configurations, the pros and cons of choosing the configurations of these choices.

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