



The collaborative realization of public values and business goals: Governance and infrastructure of public–private information platforms



Bram Klievink *, Nitesh Bharosa, Yao-Hua Tan

Delft University of Technology, The Netherlands

ARTICLE INFO

Article history:

Received 9 October 2015

Received in revised form 2 December 2015

Accepted 6 December 2015

Available online 21 December 2015

Keywords:

Transformation

Public–private platforms

Platform governance

Information infrastructures

Collaborative governance

e-Government

Business-to-government

Open innovation

ABSTRACT

The scale of society's evolving challenges gradually surpasses the capacity of the public sector to address them. Coping with these challenges requires budget-short governments to look for innovative ways to transform and improve their operations and service provisioning models. While in many cases transformation starts from the inside-out (based on policy goals) and focuses on reorganization through ICTs, we notice a different class of initiatives in which external ICT developments are capitalized by governments to transform from the outside-in. One category of ICT innovations that is especially promising for such a transformation is that of information platforms (henceforth platforms), which can be used to connect different stakeholders; public and private. Platforms are not new. Yet, there is not much research on using public–private platforms as part of a transformation effort, the (policy) instruments that are involved, nor about dealing with the cascading multi-level challenges that transformation through platforms offers. This paper addresses these knowledge gaps by drawing on empirical research embedded in two long-term endeavors: (1) standard business reporting between businesses and government agencies and (2) international trade information platforms. In both cases, platforms are being collaboratively developed and used by a collective of public and private organizations. These initiatives reveal that government agencies can steer and shape the development of public–private platforms in a way that enables businesses to pursue their own interest whilst transforming business–government interactions and more generally serving collective interests and public value. Our findings indicate that once a public–private governance structure is accepted by stakeholders and adapted to fit with the technical dimensions of the information infrastructure, even platforms that are driven by the private sector can start to evolve in a way that enables extensive transformation of the operations of government.

© 2015 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

1. Introduction

Almost every organization is required to report to stakeholders or government agencies on their performance, enabling these actors to determine the level of compliance with social norms, policies, laws, regulations and provisions in contracts. Business-to-government (B2G) reporting can include areas such as finance, taxation, social security, environment, health, education and labor. Over the last decades, each of these areas has yielded a dedicated reporting chain or even multiple chains within these areas. Traditionally, the ways and formats for B2G information exchange is prescribed by government agencies, each of them with their own processes and interfaces. As a result, organizations now have to deal with various administrative and information reporting processes that can be very different, even though they often require the same or similar data elements. In the current networked environment, businesses increasingly expect that government agencies cooperate with each other, harmonize information requests and interact with

businesses in a uniform way. This however demands extensive transformations, truly changing the way public agencies define, request, and process business information.

The transformation of government, in terms of changes in the organization, operations and governance of the public sector, has been an important topic in electronic government and public sector reform for a while (Borins, 2014; Janowski, 2015). The objectives of such change at least include making savings in public spending, improving public services (in quality and effectiveness), and making the operations of government more efficient (Pollitt & Bouckaert, 2004). Transformation of government goes beyond digitizing government and is about making the public sector as a whole more effective (Van Veenstra, Klievink, & Janssen, 2011). Van Veenstra (2012) distinguishes between transformation as a product (e.g. transformation in the organizational structure, processes and practice) and transformation as a process (e.g. a different way of looking at how governments create value). However, the underlying notion is still one of a government seeking to improve itself (i.e. reform rather than transform), whereas in the past decade, studies on innovation and on research-and-development in the private sector have undergone a paradigm shift, from closed to open innovation

* Corresponding author at: Jaffalaan 5, 2628BX Delft, The Netherlands.
E-mail address: Aj.Klievink@tudelft.nl (B. Klievink).

(Chesbrough, 2003). The idea of open innovation is that knowledge and technology from beyond the organizational boundaries offer the potential to do something with; to innovate from the outside-in (Inauen & Schenker-Wicki, 2011).

As budget-short government agencies are expected to transform, they should consider leveraging the innovations of others, and use and attempt to steer those innovations to fulfill the objectives of transformation, instead of focusing on improving internal processes and reducing costs, which in turn affect the environment in which government agencies operate – an inside-out approach (e.g. Irani, Elliman, & Jackson, 2007; Weerakkody & Dhillon, 2008). In other words: governments should also consider to transform from the outside-in, which constitutes a different class of transformation initiatives, in which external developments are capitalized by government agencies to transform their operations, in collaboration with others (Janssen & Estevez, 2013).

Innovation from the outside-in is based on the innovative capacity of society as a whole, in which government organizations can play a variety of roles (e.g. provide incentives, act as user, or as catalyst), instead of leading as initiator and organizer of the entire transformation. Citizens and businesses become partners, instead of primarily users. This is based on networked approaches to governance and innovation, instead of being based on hierarchical governance (e.g. De Bruijn, Ten Heuvelhof, & In't Veld, 2010). These kinds of innovations, especially when they occur through (collaborative) platforms, are often studied in the business-to-business domain (Gawer & Cusumano, 2013). However, how transformations can be achieved via collaborative (development of) platforms by networks of public and private organizations is rarely studied. This leaves a void on how government agencies can take advantage of *collaborative public-private information platforms* (which we will from now on refer to as *public-private platforms*) to use societal or business innovations as part of government transformation.

Looking to advance knowledge on the understanding of how the public sector can transform the ways it interacts with businesses through public-private platforms, this paper investigates the challenges and instruments for platform-enabled transformation. The question at the center of this paper's investigation is: *what instruments can be used by governments for platform-enabled transformation and what are the challenges in applying them?* Answers to this are important as we see collaborative platforms (developed and used by public and private organizations) emerging in practice while we do not yet understand which factors impede or stimulate transformation. We draw on empirical research embedded in two of such recently developed platforms linking the public and private sector: (1) standard business reporting between businesses and government agencies and (2) information platforms for international trade. In both cases the information systems of business are taken as a starting point for transformations.

This paper proceeds as follows. Section 2 provides a more substantive treatment of collaborative platforms in general and argues why these represent an embryonic research area. Section 3 explains the research approach followed in order to answer the research question. Section 4 describes the background of the two cases. Making a cross-case comparison, Section 5 focuses on the challenges and instruments employed to stimulate transformation. Together with the findings and discussion of their implications, as described in Section 6, this answers the central research question. This paper ends with conclusions on collaborative public-private platforms, in Section 7.

2. Theoretical background

2.1. Overview: overarching themes on platforms

Platforms have become an important topic, studied from various perspectives. We provide a brief overview of the research on three recurring and overlapping perspectives: functional, structural and organizational. Dominant themes in literature include value creation,

collaboration, business models and information infrastructure. The challenges described in literature span these perspectives and themes.

From a functional perspective there is much research on industry platforms (Gawer & Cusumano, 2013), where a platform acts as a foundation upon which others can develop complementary products, technologies or services (Gawer, 2009). Value creation is a dominant theme in this line of research. Platforms act as intermediaries between two or more groups of agents, for example in the form of Multi-Sided Platforms (MSPs) to organize economic transactions (Hagi & Wright, 2011). Hagi & Wright (2011) define an MSP as “an organization that creates value primarily by enabling direct interactions between two (or more) distinct types of affiliated customers.” (p. 2). Platform creation draws on the notion of collaborative value creation instead of mere competition (Osterwalder & Pigneur, 2010).

From a structural perspective, platforms are often described as technical artifacts, for example the interfaces that actors develop to connect to a platform, which can outlive the platform (Tiwana, Konsynski, & Bush, 2010) and will thus affect the technical landscape regardless of the success of the business strategy of e.g. the platform leader. Eaton (2012) argues that digital platforms are a specific form of digital infrastructures, “configured as an industry platform and that makes available digitalized components [...] which act as foundation upon which developers can build complementary services” (Eaton, 2012, pp. 14–15).

From an organizational perspective, studies on platforms often address questions like how to become a platform leader (Gawer, 2009), how to make money on offering something via a platform (Eaton, 2012), or on the role and level of control that developers have (Tiwana et al., 2010). The underlying assumption is that a platform can be beneficial both to every individual actor and to the collective. However, as Barringer and Harrison (2000) argue, networks of stakeholders are difficult to organize and manage, particularly as the number of actors involved increases. Still, questions concerning governance and control are often overlooked or only addressed from a narrow view on platforms (Tiwana et al., 2010). There are papers focusing on participative platforms developed by government agencies (e.g., De Reuver, Stein, & Hampe, 2013; Slaviero, Maciel, Alencar, Santana, & Souza, 2010; Welch, 2012). Still, most of this research focuses on either government-to-government or government-to-citizen interactions. The development of platforms in the public-private domain remains a relatively understudied domain. A major challenge for platforms as a socio-technical manifestation of a collaboration between parties from both the public and the private sector, is that the private sector business models should be aligned with the action and values that have to be created by government organizations (Janssen, Kuk, & Wagenaar, 2008).

Drawing on the conceptualization of a platform as a socio-technical concept (Baldwin & Woodard, 2009), we argue that both the *information technology (IT) infrastructure* (e.g. interfaces and services) and *governance mechanisms* (e.g. multiple user groups of the infrastructure, terms, conditions, decision-making structures, and stakeholder objectives) should – in interaction with each other – be addressed when studying public-private platforms as a means for transformation as both offer specific types of challenges and present different types of instruments. We discuss these two focus areas in turn as the background to and analytical lens for our study of the cases.

2.2. Focus area 1 – the platform's information infrastructure

Digital Information Infrastructures (II) are used to describe shared, heterogeneous systems that emerge and evolve through the interplay of technology, users, providers, and policy-makers (Janssen, Chun, & Gil-Garcia, 2009; Tilson, Lyytinen, & Sørensen, 2010). Digital infrastructures can be used by a wide variety of actors, with usage, roles and types of actors evolving over time (Janssen et al., 2009). They include technological and human components, networks, systems and processes that contribute to the functioning of a specific information system (Braa, Hanseth, Heywood, Mohammed, & Shaw, 2007). The information

technology infrastructure of platforms refers to the interdependent and interconnected collections of technical components across organizational boundaries (Gal, 2008; Tilson et al., 2010). Actors can extend the infrastructure and integrate it with their own operations.

Apart from infrastructural components such as systems and networks, the more technical components typically include standardized information exchange processes, data models, taxonomies, technology specifications, web services, authorization and authentication facilities, and security including public key infrastructures. There are many variations possible, some of these may be modular components related to the platform, whereas others really define the platform, as is the case with for example the platform's interfaces. Taken together, these components provide a platform upon which organizations can provide services and applications. They are thus not simple, standalone and self-contained information technologies, but rather represent large and open networks of heterogeneous systems and the actors that own, operate and use them (Nielsen & Aanestad, 2006). These various actors have different perspectives on and only partial control over the II as a whole. As a consequence, conventional approaches to designing information systems may not necessarily work; no single actor has control over all the components and an II is not built from scratch (Hanseth & Lyytinen, 2010). New challenges become prominent, such as for example those related to overcome start-up problems and avoid lock-in (Hanseth & Lyytinen, 2010). A particular difficulty here is the division of shared cost for the infrastructure maintenance and developments, especially since the costs and benefits are often distributed unequally across the various stakeholders. These challenges require that decisions be made by the fragmented actor community involved (for example through open (Chesbrough, 2003) or social (Klievink & Janssen, 2014) innovation approaches), which brings us to the issue of governing these platforms and the collaborations that enact them.

2.3. Focus area 2 – the governance of platforms

Platform governance refers to the solutions that organizations devise for problems of coordination (Markus & Bui, 2012). There are two generic types of governance that are relevant to understanding platforms and, more specifically, to understanding how platforms can be used as part of a transformation effort. On the one hand, governance refers to processes, social practices and activities, performed by institutions or actors (Bevir, 2013). On the other hand, there is the more tangible, formal part of the structure, control and processes for decision making (Von Tunzelmann, 2003). These include instruments and mechanisms such as laws, administrative rules, practices, decision making processes and institutional arrangements used to align the various characteristics of demand (e.g. information users) and supply (e.g. information providers and IT-service providers) (Cusumano, 2005; Lynn, Heinrich, & Hill, 2000).

Governance serves to come to agreements on (technical) standards and procedures that guide the activities of the large numbers of organizations involved in a platform. Governance is important because it is believed to contribute to the efficiency and effectiveness of inter-organizational arrangements (Provan & Kenis, 2007). Specifically related to platform governance, Tiwana et al. (2010) identify three main elements: the partitioning of decision rights, formal and informal mechanisms of control, and the ownership structure. We follow this structure and discuss each of them in turn, paying attention not only to the structural aspects of governance, but also to the process aspects.

The *decision-making structure* is about who decides, how, and on which components of the platform in terms of functionality, design and implementation. It also dictates who has control over the interfaces and thereby over the evolution of the platform (Baldwin & Woodard, 2009; Tiwana et al., 2010). There often is some degree of decentralization of authority and responsibility for different types of decisions. An important question is how and when decision rights should be shared, often a question of balancing autonomy of parties and coordination of

the platform (which is a challenge for other forms of public–private collaboration also, see Klievink, 2011; Tiwana et al., 2010).

Tiwana et al. (2010) identify different formal and informal *mechanisms of control* over the platform (i.e. to encourage desirable behavior by actors involved), including input control (where an owner decides what goes on the platform), process control (methods and procedures prescribed to parties), and informal control (e.g. values, norms, and trust) (Tiwana et al., 2010). In business-to-government reporting, there typically is a formal relationship and an obligation to report to government. However, beyond that, parties are autonomous and thus the development of the platform needs to be in the interests of – indeed even driven by – the businesses, whilst at the same time offering the opportunity to government agencies to capitalize on these developments to transform the way they interact with businesses. This means that government agencies are stakeholders having their own interests and instruments (e.g. they can make it rewarding for businesses to configure and use the platform in a way that it facilitates business-to-government exchange), but without formal authority or hierarchical mechanisms to steer the platform entirely. Trying to impose constraints or incentives may remove the “luxury” of considering not to participate, but this may threaten the collaborative nature of the partnership underlying the platform (Johnston & Gudergan, 2007). Apart from the formal governance instrument (i.e. the agreed-upon decision making structure), overall a collaborative form of governance is needed, as traditional modes of governance (e.g. hierarchical, authoritative, and contract-based) may be counterproductive in making the platform successful (Gawer, 2014). Balancing some kind of steering of (or control over) the overall platform with the autonomy of the actors that participate in it is especially challenging for platforms joining-up public and private parties; the innovations have to make business-sense, and advance the agenda of government agencies.

Next to the decision-making structure and control mechanisms, a third category in platform governance is the *ownership structure* (Tiwana et al., 2010). A platform can be proprietary to a single firm (i.e. the platform leader, especially if the platform is the core business strategy of the actor), or ownership is shared between multiple actors. In case the government puts heavy requirements on the platform without ensuring that the platform offers sufficiently for businesses, control over parts (e.g. the interfaces or at least the standards) are likely to end up with government. An important element especially in proprietary solutions or shared ownership is the (perceived) neutrality of the platform, especially when it comes to data that are commercially sensitive.

2.4. The conceptualization of platforms in this study

Platforms thus are socio-technical artifacts that can transform the way actors interact with each other. They can be considered IT-based inter-organizational arrangements, in which the platform acts as an inter-organizational coordination hub (Markus & Bui, 2012). It is therefore as much about the relationships between actors as it is about the technical platform itself. In collaborative platforms as a tool for outside-in transformation, reciprocity (Oliver, 1990) and stakeholder considerations (Barringer & Harrison, 2000) are likely to play a bigger role than in traditional business–government relationships, based on necessity (e.g. meeting regulatory requirements) and legitimacy (e.g. compliance) (cf. Oliver, 1990).

Governance and infrastructure are thus interrelated aspects of a public–private platform; the shared technical components and building blocks (such as systems, interfaces, ontologies and data standards) of platforms require joint decision-making in which a balance needs to be found between the autonomy of actors in the way they interact with the platform, and the level of control needed over the collective asset (i.e. the platform). Based on this observation, we provide a definition to include both governance and information infrastructure and define a public–private platform as a *governance structure and information infrastructure interconnecting two or more distinct types of affiliated and*

collaborating actor groups, from both the public and the private sector. In the context of e-government, it is a means to directly connect government and the public (businesses, in our study) to create public value and in which actors on both sides are able to provide and influence components and functionalities and have certain control over the information in the platform. Especially after the financial crisis, government agencies need to perform more tasks (e.g. more inspections and audits) in a more complex world, but with fewer resources (due to cutbacks in budget). Businesses on the other hand want to exhibit that they are in control (to stakeholders and partners) and want to reduce their administrative burden (including the cost of compliance). This nexus creates new opportunities for research and theory development.

We argue that researchers can make strong contributions to the development and adoption of collaborative public–private platforms by helping the stakeholders (such as policy makers, businesses, IT providers and practitioners) understand which obstacles they might face down the road and which strategies can help them overcome the obstacles. Through empirical research, we make a first step in conceptualizing platforms in a public–private context. In the case studies, we pay attention to the IT aspects of the platform, the governance of the platform and of the collaboration that drives it, as well as to the interactions between the platform infrastructure and the governance.

Following the theoretical background, there seem to be two major challenges to utilizing public–private platforms to transform business-to-government interaction; balancing control with autonomy and aligning business models and interests with public values and the government's transformation objective. In the empirical part of the study, we look at the challenges that surface and how they are dealt with. Especially the role of government is interesting given the tension between the need that governments rely on collaboration for a decentralized platform innovation on the one hand, but on the other hand also need to control for that the platform meets the transformation objective.

The literature offers clues for what *types of instruments* may be employed to address these challenges, including instrument types related to the governance of public–private platforms and instruments related to the platform infrastructure, as described in this section. The types of instruments include decision rights and decision making structure; control over the infrastructure; control over the interfaces; incentive structures; building partnerships; collaboration processes; data governance; ownership structure; and the selection and maintenance of standards. For the cases, we use the notions from the literature described in this section to find out what instruments are used for each of these types and seek to understand how they are used in an effort leverage business innovations as a tool for outside-in transformation of business-to-government information exchange.

3. Research approach

This paper draws on data collected from two empirical cases in the form of two research projects aimed at developing a platform that would transform business-to-government reporting. Both these projects concerned a combination of research and the technical development of an IT artifact (the platform). The design of the IT artifact was done in various iterations, through the collaborative design and improvement of the artifact by policy makers, architects, end-users, solution providers and researchers. The projects themselves (though not the research we present in this paper) could be considered a form of action design research, as described by for example [Sein, Henfridsson, Puro, Rossi, and Lindgren \(2011\)](#). Within the projects, the research process was inherently interwoven with the design, building and evaluation of the information platforms that were developed within a collaborative and organizational context. Given our goals for the case study, we hence selected the two cases based on the criteria that they constituted an effort to transform business-to-government reporting, were driven by public and private parties in collaboration, that they

featured the development of an information platform. The first project concerns the development of a platform for Standard Business Reporting (SBR). This development was studied from January 2011 until October 2013. The second research project focuses on the development of information platforms for data exchange in international supply chains. This research covers the initiation, development and deployment of the platforms from June 2010 until September 2013. Both cases focus on transformation through collaborative public–private platforms. The SBR case (case 1) focuses on a single platform in a national context. The international trade case (case 2) covers two platform variants, both in an international context.

This paper takes these projects as cases following a qualitative case study methodology, given the nature of the research question, the material available, and our aim to explore what instruments and challenges play a role in cases of collaborative platform innovations. A case study approach is now possible as both projects have reached finalization and we make use of that by assessing the whole of the developed platforms, their (inter)organizational context and the transformation process that took place. The fact that the authors were also involved in the research and design in the projects means that we had full access to all case details. However, our collaboration with practitioners in synthesizing challenges and instruments and documenting findings does pose a challenge to the reliability of the research. As our goal is not the representative capturing of all possible variations of transformation through platforms, but to gain a deeper understanding of how platforms can be used in a transformation effort and to explore instruments and challenges used and encountered, we think that the benefits of having in-depth information of the transformation efforts outweigh the consequential generalizability limitations. Furthermore, there are now many public sources (deliverables, papers and a book) that describe the projects, which would assist in replicating our findings. The unit of analysis is the combination of the information platform and the governance in the public–private collaboration. In an effort to address methodological concerns, for both cases we built a case study database ([O'Reilly & Kiyimba, 2015](#)). [Fig. 1](#) illustrates the research approach.

Multiple research instruments were employed in order to collect data that was necessary for delivering project results such as memo's, clarifications, progress reports, architectures and prototype's. For this research paper, we created a document corpus with specific project documents (e.g. meeting reports and architecture descriptions) and combined them with the insights gathered from interviews. Throughout both projects a series of interviews were conducted. Respondents included project members, (IT) architects, business managers and policy makers. The interviews were semi-structured and gravitated around questions concerning the design (issues and choices) of the platform, specifically related to the infrastructure and the governance thereof. We also draw on some findings from project workshops. In the

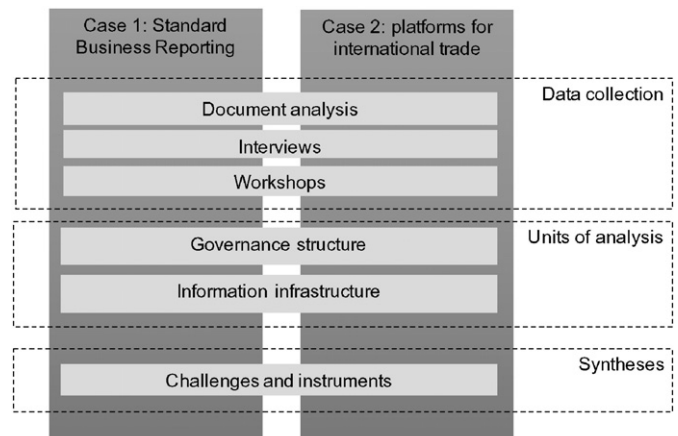


Fig. 1. Research approach.

international trade case, four workshops were organized; in the SBR case we had two workshops. The workshops helped in exploring design issues with both businesses and government agencies. Workshop notes were shared with the participants for fact checking. Furthermore, we sent (aggregated) case reports and analyses to the respondents and asked them whether our understanding was correct. Table 1 shows the sources of data for our research as well as roles of interviewees.

Both cases also cover the phases of the actual development and implementation of the platforms, allowing us to capture more data as the projects evolved. In this paper, we focus on the key challenges and instruments surrounding the transformation through platforms. Following our analytical lens, we look at the challenges facing development and adoption of the platform governance and information infrastructure in both projects. In order to improve comparability, we first discuss context, the old and the new situation for both cases, and then (in Section 5) we describe the instruments for transformation we found in the two cases, as well as the challenges for governance and infrastructure development.

4. Case descriptions

4.1. Case 1: standard business reporting

4.1.1. Background of the case

Numerous governments have regulations and/or administrative rules demanding that businesses report data (e.g. financial) on a regular basis (Chen, 2012). These data (i.e., revenue statements and end year reports) permits mandated government agencies (e.g. the Tax Office) to conduct specific processes including registration, analysis, verification, decision-making and monitoring. Over the decades, the increasing number and complexity of reporting requirements – dictated by multiple government agencies – have led to growing administrative burdens for reporting entities (National Audit Office, 2008). In the Netherlands, the ambition to reduce the administrative burden experienced by businesses has driven government agencies to collaborate not only within the public sector, but also with the private sector (Arendsen, Peters, Ter Hedde, & Van Dijk, 2014). One result is a public–private initiative called Standard Business Reporting (SBR) that aims to transform the business-to-government reporting by setting-up a platform through public–private collaboration (Bharosa, Van Wijk, De Winne, & Janssen, 2015).

Before the public–private platform was set-up, multiple government agencies prescribed their own data definitions and reporting channels to businesses. Prior to fulfilling their reporting duties, businesses needed to check the data elements and definitions required by the respective governments agency. The data available in the existing business systems needed to be ‘mapped’ (interpreted, related and translated) to the definitions and rules prescribed by the requesting government agencies. Hence, different data definitions were used and reports were shared in different formats.

A major challenge is the lack of data definition standards and rules for business information. For government agencies, this hampers their ability to efficiently request and process data succumbed by businesses. Manually processing data extracted from paper reports is time-consuming and error-ridden, in part because of data rekeying. Even when financial information is collected electronically, but in an unstructured format (i.e. doc, xls and PDF), the integration of data elements from various data sources is difficult without a common data standard. There were different ways to provide the reports to government, ranging from mail to system-to-system information exchange, which the Dutch Tax Office provided via interfaces with some of the leading reporting software solutions. Each government agency had organized the handling of incoming reports in a specific way. Fig. 2 illustrates this situation in the Netherlands. Reporting was usually based on proprietary software applications, each dictating their own reporting standards for users. Moreover, data validation and analysis needed to be

Table 1
Data collection methods and sources.

Method	Case 1 participants/respondents	Case 2 participants/respondents
Workshops	Workshop 1 (March 2011): 15 participants (business, innovation, government and knowledge institutes); Workshop 2 (November 2012): 5 participants (business, innovation, government and knowledge institutes).	Workshop 1 (March 2013): 9 participants (business, innovation, government and knowledge institutes); Workshop 2 (March 2013): 8 participants (business, government, knowledge institutes); Workshop 3 (April 2013): 7 participants (business, IT, operations, government, consultancy); Workshop 4 (April 2013): 9 participants (business, IT audit, government, knowledge and consultancy).
Interviews	16 interviews (between January 2011 and January 2013): <ul style="list-style-type: none"> – Program coordinator – Inter-government director – 3 technical project managers – Compliance officer – Taxonomy engineer – Meta-data manager – 3 innovation managers – IT architect of platform operator – Information Process Architect – Domain coordinator – 2 interviewees involved in market development 	18 interviews (between May 2011 and Sept. 2013): <ul style="list-style-type: none"> – Manager overseas logistics of freight forwarder 1 – IT expert of freight forwarder 2 – Head of unit of global freight forwarder 3 – Compliance officer of freight forwarder 1 – Customs/compliance manager of freight forwarder 2 – Commercial director freight forwarder 4 – IT manager freight forwarder 4 – 2 IT auditors of customs in country1 – Innovations manager customs country 1 – Innovations manager customs country 2 – Secretary general of police organization – IT architect of IT solution provider 1 – Business development of IT solutions provider 1 – Director product management of IT solutions provider 2 – Solutions leader of IT solutions provider 3 – IT architect of IT solutions provider 4 – IT project manager of re-search project
Observed meetings	None	8 project coordination meetings covering platform design issues; 3 consortium meetings covering platform design and governance issues.
Documents and project reports	Documents: <ul style="list-style-type: none"> – Compliance working group (5 iterations) – Process and technology working group (3 iterations) – Intermediate project reports (2 iterations) 	Documents: <ul style="list-style-type: none"> – Integration architecture (4 iterations) – Implementation reports (7 iterations) – Data security framework (3 iterations) – Business–government interaction protocols (5 documents) – Evaluation reports (5 documents)

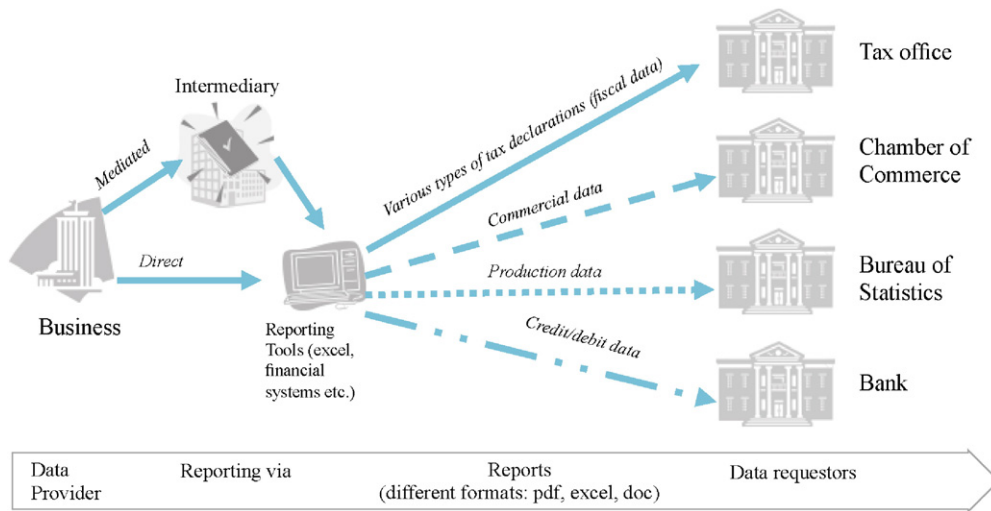


Fig. 2. Simplified pre-platform architecture: multiple data format reporting.

conducted and manual manipulation of information from disparate sources was needed to create uniform reports. To conclude, in the pre-platform situation, companies and their intermediaries were left with the problem and cost of identifying what piece of information their accounting or other systems hold and mapping that information multiple times for different reports. The main challenges in this case are the fragmentation of data, systems and government requests; the lack of standards; the information system integration; the high administrative burden; and the errors in data and reporting, hampering the effectiveness of government processes and the compliance of companies.

4.1.2. Realized situation: a 'store once, report to many' platform

The SBR platform is enabled by recent developments and implementations of a XML based language known as eXtensible Business Reporting Language (XBRL). XBRL have demonstrated some initial success in addressing the challenges discussed earlier. One of the first major steps was to decide on standardization of data (syntax and semantics), resulting in a "National Taxonomy Project". XBRL makes it relatively simple to develop and widely adopt a data taxonomy – a dictionary that can be employed to normalize and harmonize the reporting terms used (Debreceeny, Felden, Ochocki, & Piechocki, 2009). Such a taxonomy enables the development of reporting software applications to make the financial information machine-readable (Bergeron, 2003). Once stored in XBRL format, businesses can transmit the information electronically to government for reporting purposes. Hence, the burden of manual processing can be significantly reduced. Government agencies, when using XBRL as a standard, can be more efficient in gathering and analyzing financial and business information. XBRL also allows for business rules to be embedded, which enables automatic validation of business rules in financial reports (Müller-Wickop, Schultz, & Nüttgens, 2013).

Due to its extensibility and the potential to eliminate data rekeying throughout the information chain, XBRL is expected to revolutionize the interactions between reporting businesses, intermediaries and government agencies (Pinsker, 2003). However, this requires more than data standardization. Information exchange using XBRL also requires an adequate information infrastructure consisting of several components (e.g. interfaces, automated processes, reporting software and web services) of public and private organizations. In 2006, an information infrastructure project was carried out drawing up requirements for the functionalities necessary for a new automated process infrastructure that provides shared services for multiple government agencies. Examples of shared services include message specific sender authentication, syntax and semantics checks, error handling, forwarding to the appropriate government agencies and return messages (acknowledgements).

In 2008, the first version of the information infrastructure (called Digipoort) developed for exchanging data based on XBRL was operational. After three years of smaller pilots, since 2013, the Dutch Tax office decided to make the information infrastructure its primary means for accepting certain tax reports. This moment can be considered the tipping point in infrastructure adoption securing the necessary critical mass needed for viable business model for the platform. In terms of the instruments we set out to identify; the government created incentives for use and ended up mandated the use of the platform for some information flows.

Fig. 3 shows the current situation in the Netherlands with reporting (using the platform and the taxonomy) to the Bureau of Statistics (i.e. production statistics, investment statistics and short term statistics), Chambers of Commerce (i.e. year-end financial report, tax documents for publication, fiscal condensed) and Tax Office (i.e. income tax return, report concerning intracommunity performance, turnover tax return).

The platform in the SBR case is based on a 'store once, report to many'-architecture. That means that although the data definitions and the infrastructure may be re-used over different reporting chains, the actual act of reporting remains specifically addressed to one agency. Basically, there are two reasons for this. First, legislation does not allow re-using data that is collected for one purpose (e.g. tax) to be used by other agencies for other purposes. Second, because the various actors request data based on different legal bases (e.g. tax versus commercial), reports may use the same data but end up with different interpretations. For example, in a tax report, the company will try to report as little revenue as possible in order to pay as little tax as possible. In a year-end financial statement meant for shareholders, a company will try to report as much revenue as possible, to appear as a solid investment opportunity. Currently, the various government agencies are looking at ways to harmonize the legal bases for their data request. Non-technical components of the platform are thus still challenging today.

4.2. Case 2: information platforms for international trade

4.2.1. Background of the case

Similar to the SBR case, actors involved in international trade also report a lot of data to governments and other parties in the chain. Specific for this case is that there are a lot of handovers between the companies in the supply chain before the information is provided to the government by one of those companies, which thus has to pass on second hand information. In the current situation, the information is fragmented and information quality can be so poor, that parties interested in what is inside a container and on what ship it is (e.g. customs for enforcing safety and security and the buyer for tracking their

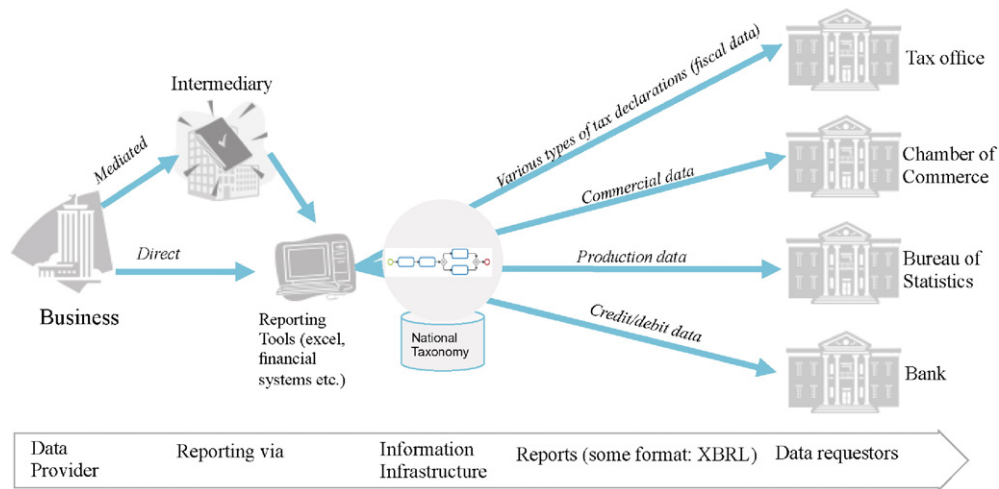


Fig. 3. Simplified post-platform architecture: Store once and report to many.

goods) cannot collect electronic information of adequate quality. In the interviews we held, we found multiple reasons for this, including complex contracts, contractual and historical relationships, and the fragmentation of operations and information in a supply chain. Due to reasons of commercial sensitivity, a high-level (or even vague) description of the contents of a container find their way in the transport documents, accompanying it further down the logistics lane and feeds the declarations towards customs and other government organizations. Buyers, sellers, customs and other parties in the supply chain have to manage and supervise the supply chain with second-hand information that is filtered, altered and likely to be inaccurate (for an analysis of the existing situation, see e.g. Hesketh, 2010; Klievink et al., 2012). Fig. 4 illustrates the current information system in international trade.

A major challenge and driver for the transformation initiative in this case is that the effort put in collecting data from various sources (even despite their low quality) leads to a high administrative burden for businesses and makes government (risk) assessments unnecessary resource-intensive. Similar to the SBR case, a lack of agreed upon standards for data, including those for structure, semantics and sharing of data, make it very challenging to improve information sharing throughout the chain. To further complicate matters, there are many legacy systems in place and IT maturity of parties in the chain varies greatly. As most businesses operate globally, they also have dealings with

authorities in many countries, often having their own information infrastructure, interfaces, and ways to request and process data. Data validation and analysis often requires a lot of manual effort on the government's side, which in turn leads to additional (and often manual) information requests to companies.

These challenges formed the reason for a consortium of globally operating businesses (including leading logistics service providers and IT service providers), government agencies in Europe (including customs from multiple countries), and research institutes to set-up a Research and Technical Development (RTD) project to transform the way the information system in international trade works, specifically when it comes to business-to-government reporting.

4.2.2. Realized situation: supply chain visibility through a public-private platform

Also in this case, the public-private consortium started from the idea that innovations in ICT now make it possible to improve the information exchange between actors worldwide by creating electronic connections between organizations. The systems of supply chain partners can be interconnected and jointly form international information platforms for international trade (Tan, Bjørn-Andersen, Klein, & Rukanova, 2011). Through these platforms, data can be shared among supply chain partners and with government agencies (Urciuoli, Hints, & Ahokas, 2013).

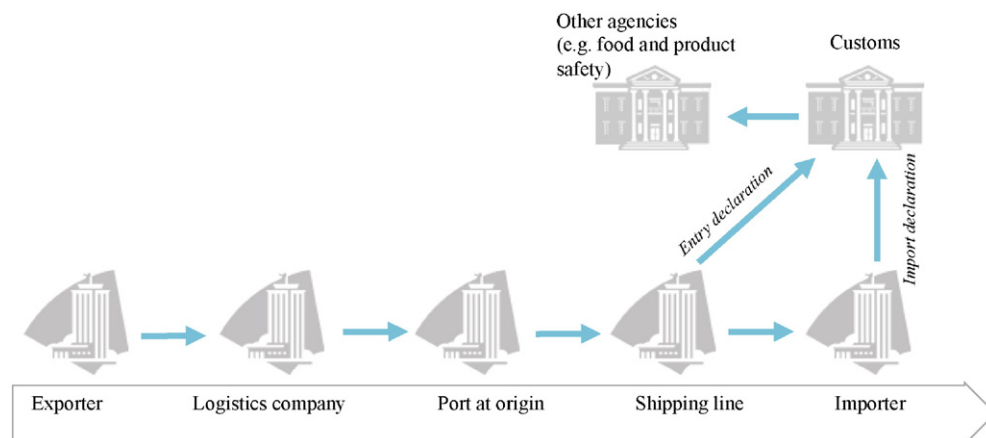


Fig. 4. Simplified pre-platform architecture: second-hand information.

These platforms can greatly enhance the visibility on and control over the supply chain, both for business (e.g. buyers and sellers) and government inspection agencies (e.g. customs and food- and product safety).

To get full visibility on the goods actually entering the country, government supervision authorities such as customs, would need to be able to query the information systems of all of those parties involved in the shipment (Klievink et al., 2012). To this end, the project developed and demonstrated an information infrastructure in which the parties participating in a supply chain provide data that can be relevant to other supply-chain parties and in which security capabilities can be integrated (Urciuoli, Sternberg, Ekwall, & Nyquist, 2013). The information shared between the parties includes transactional data (captured by buyer, seller, and intermediate parties in the supply chain), data on the flow of physical goods, and on the management of (commercial) risks. The project focused on four main topics: 1) the development of an information sharing architecture with emphasis on the interface definitions, data standards, and semantics; 2) the development of new organizational and inter-organizational processes and practices, for instance on supply chain risk management and risk-based supervision; 3) the development of new business–government interaction protocols, including the transformation of government supervision based on the information exchanged via the platform; and 4) the application of these topics to practice in so-called Living Labs, using a collaborative process in which the new practices were applied, tested, and refined. All of these topics were addressed collaboratively and the process of getting results included sharing decision-making rights.

The infrastructure is now operational, but only on a limited number of trade lanes. As in the SBR case, standardization of data and data exchange is key for adoption by more companies and for more trade lanes. Ideally, the information infrastructure should be fully distributed (Hofman & Aldewereld, 2014). This would require that the information systems of all companies open-up using the same standardized interface. At this point in time, this is not realistic, given the varying levels of IT maturity of especially smaller actors in the supply chain. Furthermore, just opening up systems, without fully knowing where the data could go, was a bridge too far for the companies involved. The de-facto solution that came from this is that a number of companies offer platforms and are able to access and aggregate data on specific supply

chains. Therefore, multiple platforms were developed as part of the project.

The key challenge that the project had to address is how businesses can develop commercially viable platforms that exchange business data whilst at the same time make sure that an open international system of interconnected platforms arises, which is able to connect a wide variety of supply chains to numerous government agencies in multiple countries. The result of the project is a distributed system-of-systems, in which multiple platforms are offered via three models: platform as a service offered by IT solutions providers, supply chain platform initiated and operated by a lead supply chain actor, and platforms developed and operated by a community of companies (for example those in a port), sometimes with involvement of a government agency. The project developed data (exchange) standards and interface specifications that enabled all of these different platforms to connect to each other, each opening up primary information systems of the businesses in the supply chain they operate on. The interconnected platforms create full supply chain visibility for the buyer and/or owner of the goods and government inspection agencies via so-called ‘dashboards’, which support business-to-government reporting whilst also facilitating business-to-business information sharing. Many of the platform providers identified business opportunities in value-added services (e.g. logistic apps for improved synchro-modal planning, enhanced risk management, and data validation services) that could be offered via the platform. This is vital, as the stated aim of the project was to come up with business solutions that make business-sense but that could also be used to transform business-to-government information exchange and government supervision of supply chains.

Fig. 5 shows the simplified architecture of the platform situation. Note that in theory each supply chain could use a different platform. As long as the interfaces and data messages are according to the standard, they can be interconnected and the government dashboard can query all of them.

In this way, the platforms offer a host of functionality related to the visibility of international trade lanes to businesses, as well as enable better information exchange among supply chain partners. At the same time it enables innovations in government supervision of complicated international trade lanes as governments can re-use the data and

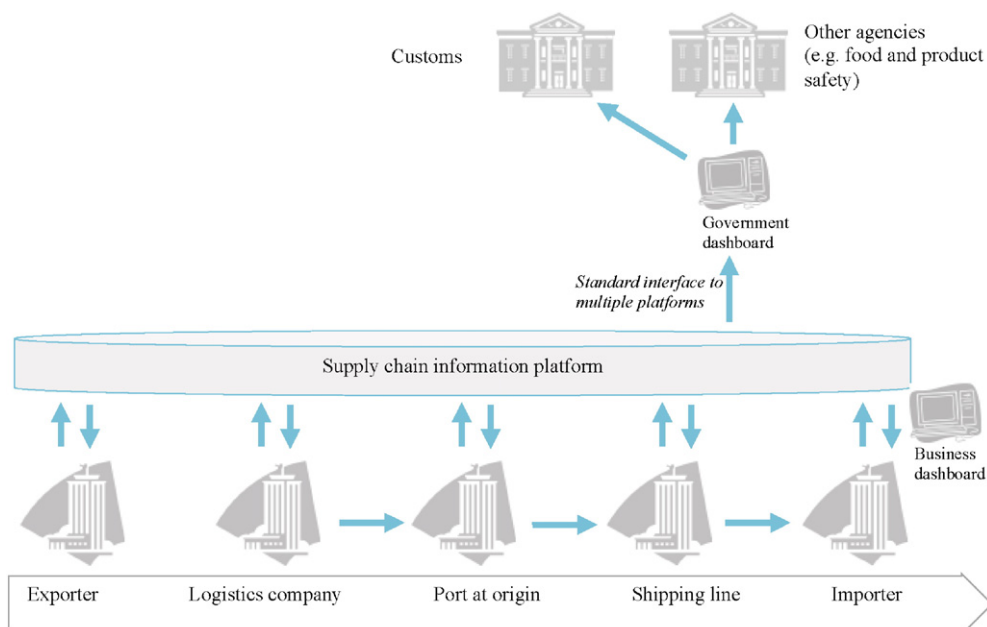


Fig. 5. Simplified platform architecture for B2B and B2G data exchange.

functionality that the private sector platforms offer. The fact that this is driven by private sector platform solutions also makes the approach a viable strategy for government to transform from the outside-in. However, in the project, government agencies had to facilitate by incentivizing the business community (primarily by offering new, less intrusive supervision concepts for parties that use platforms for submitting information to government). Real transformation requires that large volumes be submitted using the platform, which is still not the case.

5. Cross-case analysis and comparison: challenges for transforming through public–private platforms

In this section we describe our analysis of the two cases in terms of the main challenges to transformation that the cases revealed as well as the instruments that were employed to address them. Following the distinction we made in the background between platform governance and the information infrastructure, we found challenges to both. Before proceeding to the comparison and analysis across the cases, we need to be explicit on one major difference between the cases. The trade case is situated in an international context and SBR in a national context. Aside from the usual differences when comparing international and national cases (i.e. cultural, historical and institutional) we need to point out that the Customs agencies in the international trade case are limited in their ability to prescribe standards or impose decisions, because much Customs legislation and mandates are dictated at the level of the European Commission and not by national governments. In contrast, in SBR the Dutch Tax office has the means to prescribe standards, for instance through changes in the national laws and regulations. Influencing international policy development by national Customs agencies is much harder and additional dependencies arise.

5.1. Challenges and instruments regarding platform governance

Despite having similar goals, the two cases have a different approach to governance: the SBR case has a strong government role in the governance of the platform, whereas the International Trade case relies on private sector governance, with the public sector working ‘behind the scenes’ to promote making choices that benefit government as well. These differences follow from the characteristics of the cases with respect to the balance and organization of the public and private sector stakeholders.

Some of the functionalities and services that are part (or even a driver) of these transformations are – according to the current laws – the responsibility of government agencies. This applies to both cases, but is more articulate in the SBR case. For example, in the SBR case the platform provides generic services on the behalf of a specific government agency (e.g. verification of the sender, checking the submitted XBRL document against the national taxonomy, and validation of destination). This means that commercial parties cannot formally provide such services and own the underlying information infrastructure. Here lies an obstacle since several market representatives were involved in SBR for standard selection, taxonomy creation and decision-making. Ultimately stakeholders decided on a dual governance structure to address the main governance elements identified in [Section 2](#): a public–private governance structure for the constellation of standards and agreements and a public governance structure for the information infrastructure – which is officially an asset of the Dutch government. Private parties do not have a say in the governance of the information infrastructure. One of the advantages of this agreement is the stable public funding.

In the International Trade case, such a solution is not possible, as there is not a single lead actor with the power or jurisdiction to decide on a solution or to govern an infrastructure covering many international trade lanes and a diverse business community. There is a need for agreeing on key infrastructure components – especially for joining-up the

platforms at the international level – that allow platforms to balance between a value proposition and revenue model for a specific (trade lane) community and simultaneously harmonizing the way data from multiple communities are opened-up to authorities. The innovation model allowed IT solution providers to develop platforms with their own business models. The cross-platform aspect then has a limited infrastructure, but is based on open standards, emphasizing the need for governance at that level. Instead of fully funding and developing their own infrastructure, government agencies can attempt to (softly) steer the business development in a way that the infrastructure also supports government tasks. This was done by influencing choice of standards and infrastructure requirements. Such a background role for government contributes to a level playing field, which is important in the international trade case since commercial parties can provide platforms and services. Governments together with trade associations promoted the use of globally used electronic message standards (see next section) to ensure the different types of platforms offer key functionality for business-to-government exchange. That said, the ownership structure and partitioning of decision rights in specific platforms (two core governance topics described in literature) are still topic of debate, primarily when it comes to ownership of core components and for resolving issues in determining which actor has access to which data and which further investments will be made. These governance issues have to be dealt with by the private sector, by using financial instruments (i.e. penalties) that are settled in contracts. In individual trade lanes this will have to rely on a lead actor, such as the buyer or freight forwarder overseeing and organizing the trade lane.

5.2. Challenges and instruments regarding the information infrastructure

In the SBR case, stakeholders have picked a modular (loosely coupled web services) and flexible (various process sequences can be used) information infrastructure. This was an important strategic option for government agencies since the information infrastructure is expected to facilitate more reporting chains in the future (e.g. the reporting of schools/educational facilities to government and public housing corporations), furthering the transformative character of the innovation. This option is also safeguarded by the use of XBRL allowing for the extension of taxonomies. This has an effect on the processes, data and technology layers of the SBR information infrastructure. The processes refer to the automated activities that are activated for the verification and transfer of messages (in XBRL) between businesses and government agencies (and vice versa). These processes are modeled using the Business Process Modeling Notation (BPMN). The notation allows for the unambiguous description of activities. The resulting models can also be ‘loaded’ into a BPEL orchestration engine. This engine represents the technology layer of the architecture and uses the BPMN model as ‘script’ for evoking web services for the automated handling of processes (e.g. verification of sender and validation against taxonomy).

Due to the characteristics of the International Trade case, such a coordinated approach is not feasible there. There is a need to be able to accommodate a wide variety of systems and approaches. Therefore, the emphasis was on a network of different available platforms with different business models but that are semantically connected by unified interfaces. A prerequisite for implementing such a federated system is to have a standardized, uniform means to describe, offer and discover data that are used for interaction. This means that data-sharing standards are essential. Two types of data standards were found to be of importance: the trade or customs data standards and the IT standards needed for interoperability and Web service message exchange protocols. The World Customs Organization (WCO) data model version 3 and the Core Component Library of the UNECE Centre for Trade Facilitation and Electronic Business (UN/CEFACT) are the most prominent trade and customs data standards, and were therefore promoted to the IT solution providers by trade associations and government. Consequently, the standards that the IT solution providers agreed on are based on

UN/CEFACT. UN/CEFACT developed the ebXML an XML architecture for trade and business electronic documents. These standards promote semantic and syntactic interoperability and support overarching visibility solutions for authorities to query these various solutions and pull the data needed from them. The standard is used to create a uniform layer over platforms that can vary in form or function, as long as they capture source data and can be used in a public function through the standard interface. The most viable configuration for case was interconnecting platforms offered by private IT solution providers, each covering a certain community operating on one or more trade lanes.

5.3. Overview: challenges and solutions

In summary of the case findings, Table 2 provides an overview of the challenges and the solutions the cases used to address these challenges. In the next section, we draw findings from this comparison in the form of instruments that can be used to transform via public–private platforms.

6. Instruments for transformation and implications for policy makers and researchers

Even though the case studies are in different domains (international trade information sharing versus national business reporting) the challenges for platform-enabled transformation show remarkable resemblance. In both cases, businesses were reluctant to join in platform development. Even though they already had advanced information systems and controls, the implementation of some standards (i.e. interfaces, incorporation of taxonomies) was required. The instruments

employed by government agencies are however different, in part because of the means of dictating standards by law. The architecture for the information infrastructure in both cases is also very different. In the SBR case a store once, report to many architecture is realized, in which data that is stored in XBRL can be used for compiling multiple reports. Here one type of platform is found in which the government agencies own and control a large part of the information infrastructure (Digipoort). We call this vertical standardization since processes of multiple government agencies are standardized and provided as such services through Digipoort. Private organizations are involved in decision-making surrounding the development of standards impacting the direct interactions with government agencies (horizontal standardization). In the international trade case, government agencies look to re-use original business data and controls by help in setting-up various forms of platforms (commercial, community) that adhere to standards agreed upon in collaboration. This case demonstrates the existence of a second type of platform provided and owned by commercial parties, but leveraged for transforming government operations. Both cases thus demonstrate how public and private actors engage in long-term efforts to standardize information sharing. Businesses can benefit from sharing investments in the development and maintenance of interfaces to multiple government systems. Governments can benefit by obtaining access to the original business data from business systems. Furthermore, both cases include a constellation of policy structures, governance mechanisms and standards that facilitate information exchange, while simultaneously ensuring efficiency and security in business-to-government information exchange.

Despite these similarities, the cases employ different instruments to deal with similar topics. Table 3 shows the elements that play a role in

Table 2
Challenges found in the case studies and how they were addressed.

Case	Aspect	Challenges	Solution in the cases
SBR	Platform governance	How to get businesses to implement the necessary standards for information sharing through the platform?	Representatives of businesses and intermediaries were involved early on in projects related to the building blocks of the platform. Voluntary adoption of standards was stimulated through discussions on new business models considering the potential provided by the national taxonomy. This was particularly important for getting intermediaries on board, since XBRL based information exchange could cannibalize their 'old' business. Legal instruments (i.e. future reports can only be exchanged via the platform) were only used after successful pilots.
		Infrastructure cannot be owned by private companies	A two-sided governance model was constructed: public–private governance of agreements/standards & public governance of the information infrastructure.
	Information infrastructure	Using shared data definitions	Data standardization efforts were centralized in public–private project teams that focus on syntactic standardization (XBRL) and semantic harmonization (a national taxonomy).
		Interfacing with various business systems	The platform operator was empowered to develop the necessary interface standards and guides businesses and intermediaries in the implementation when necessary.
Int. trade	Platform governance	Businesses are reluctant to invest in non-core business processes.	<ul style="list-style-type: none"> – The 'lead actor' in a trade lane, which needs visibility similar to government agencies, and is able to initiate the development or adoption of a platform for that lane was engaged in the governance structure. – Collective business model design: showcase how businesses that partner in the platform could benefit from new business models (value added services), returns on investments, and become part of a global infrastructure. – A distributed governance model was employed: business communities are brought together by a lead actor, an IT solution provider offers platform functionality for that community, and governments agree with the IT solution providers on standardized interfaces, which in turn creates added value for the platform, as it can be re-used for compliance and administrative burden reductions. – Public–private governance of agreements/standards; private components are expected to meet certain standards but are not part of the public–private governance.
		The global infrastructure (interconnected platforms) cannot be owned exclusively by private companies or government agencies	International decision-making and consensus-building (e.g. UN, WCO, and EU) with key public and private stakeholders was needed since national government agencies cannot decide about data definitions and semantic harmonization across their borders.
	Information infrastructure	Using shared data definitions	Two types of platforms were developed: (1) a public–private platform in which government agencies partly fund development and own the information infrastructure and (2) private platform in which commercial software providers fund and build the information infrastructure based on a business model allowing for information aggregation and the delivery of value added services (e.g. logistic planning apps).
		High development costs: viable business propositions needed for parts of the infrastructure	

Table 3
Instruments for transforming through platforms.

	Instruments in case 1 (SBR)	Instruments in case 2 (Int. trade)
<i>Infrastructure and services</i>		
Data sharing standards	Open XML based standard (XBRL)	XML-based global data message standard
Type of data	Aggregated data (e.g. balance sheets and end year reports)	More transaction level data (e.g. purchase orders and shipment manifest)
Standardization of data	A national taxonomy that prescribes message types, structures, semantics and relationships between data elements.	Messages are prescribed using XML schemas. Actors can use the XML schema for point-to-point data standardization.
Validation of data	Automatic, messages exchanged via the II are validated against the taxonomy.	Match data from different sources. Approach for seeking data from the source (primary record)
Information exchange infrastructure	Public–private. Shared components and services	Various commercial data sharing solutions and dashboards with common interface
Incentives for adoption/achieving critical mass	Tax office made it primary (compulsory) method for most business tax reports	Lead actors select compatible IT solutions, enabling support for compliance functions (and benefits derived from that)
Scalability	Standardized data. XBRL as extensible language enables an easy addition of new data elements to the taxonomy. Loose coupling between processes and web services (enables scaling to other reporting chains)	Common interface based on global standards. Driven by private sector solutions, with their own business models
Generic services	Authentication, authorization, audit trail, message validation and conformity checks	Common data capture interface, data source identifier
Relationship between business processes and platform	Via BPMN, BPEL, loosely coupled Web Services	Diverse approaches. One interface to government agencies
<i>Stakeholders and governance</i>		
Benefits for companies	Eliminate data re-keying, lowering administrative burden by 'store once, report to many' approach	Improve inter-organizational data sharing and coordination. Facilitate compliance
Benefits for government	Standardized digital reports. SBR means same data are used for both internal purposes and external reporting; this signals quality	Overview over multiple trade lanes using dashboard able to query multiple platforms. Re-use of business data to support supervision
Ownership	Some services are allocated to government by law; hence it must (partially) be a government owned infrastructure	Distributed infrastructure, as there is no authority at the international trade lane level. Cannot be government owned. Important role for lead actors in supply chains and for IT solution providers.
Governance structure	Dual: public–private for standards and agreements. Government for information infrastructure	Public–private for standards and agreements. Private for the infrastructure and services
Finance	Government funded information infrastructure (including message specifications, interfaces and processing services), the business bear the service fees for the reporting software (as usual).	Distributed, individual commercial platforms (with their own business model)
Innovation approach	Open innovation and open governance approach;	Joint technical development by academic institutions,

Table 3 (continued)

	Instruments in case 1 (SBR)	Instruments in case 2 (Int. trade)
	research organizations, business and government stakeholders involved, also in decision making at three levels: strategic, tactical and operational. Parties that apply SBR also get seats at these tables.	the business community and government stakeholders. Application and local adaptation through Living Labs, where smaller stakeholder groups jointly decide on the implementation.

both cases and lists the instruments that the cases employ to achieve a transformation, roughly structured according to the instrument types found in the literature (Section 2). Combined with the challenges described in the previous section, this overview of the instruments answers the two components of the research question we address in this paper. In the remainder of this section, we describe how these instruments may be used as part of a transformation initiative, of course depending on the characteristics of the situation and goals of a platform.

6.1. Bringing stakeholders together: encouraging businesses to join and governments to transform

Both cases show that transformation through public–private platforms is possible – particularly in sectors where business use advanced information systems and controls – but require much coordination and knowledge of the anticipated information infrastructure components. Businesses are reluctant to join and require incentives. In particular, the ambition to simultaneously set standards, formalize decision-making, share costs and distribute benefits equally is challenging. While the governance structure and information infrastructure influence a platform's evolutionary trajectory and differentiation, boundary resources such as decision rights, taxonomies, and technical protocols serve as tools for the strategizing around the platforms. Especially the role of standards is important: the cases show that open and neutral standards are required if the platform is to serve a public function. They also show that the government has to lead in the quest for selecting and pressing for such standards. The cases do differ in the process and the role of government in achieving this; in the international setting of the trade case, government followed a more collaborative approach and incentivizing role whereas in the SBR case, the government ultimately mandated the use of the standard. Despite both projects were collaborative in nature, the first requires governments to invest more in understanding what works for the various business communities, beyond just reducing their administrative burden (which is the obvious business benefit when transforming business-to-government information sharing).

The two cases illustrate how platforms enable governments to engage business, motivated by self-interest, in a transformed reality that serves the collective interest. In the case of international trade, better data and risks assessments should lead to safer border and higher tax incomes. The government role is visible here in pressing an open standard to be used for data exchange, and offering compliance functions in return for those that use the standards. In the case of SBR, the platform should lead to lower costs of administration and reporting for businesses, and on the long run a leaner government once more businesses make use of it. Making these initiatives work, the public–private collaborations will need to use and combine the instruments presented in Table 3, in which the combinations will be based on the characteristics of the specific technical and stakeholder context.

6.2. Shared platform governance and costs

The case studies reveal that we are still in the early stages of understanding the challenges faced and instruments employed by governments for platform development and adoption. Public–private data ownership and the reuse of data for multiple businesses and supervision processes (e.g. risks assessments by government agencies using business risk data) are tenacious research issues. The instruments listed in Table 3 show how the context greatly influences the role that government can play, which affects the ownership and governance structure, which are more government focused in the SBR case and more distributed in the international trade case. Moreover, questions surrounding the core issues in platforms such as openness and generativity have not been covered in this research but can lead to valuable insights on how to balance autonomy with control or other tools to deal with fragmentation. Future research might also consider a comparison between the platform model and other existing collaboration models (e.g. joined-up government, public safety networks and open government) developed for inter-government or inter-business collaborations.

6.3. Broad data sharing

It is important to ensure that not only government gain access to data, but business also benefit from the data sharing. For example by analyzing trends in the data or making parts of the information available to the public via open data initiatives. In the international trade case, businesses were in favor of letting governments re-use business data in the platforms, but also wanted governments to give back (aggregated) data, for example on patterns that can be found in the data and that might signal incidents or risks. Furthermore, the main drivers for supply chain partners were better data sharing and improved collaboration in the chain, more efficient data sharing with government and less-intrusive government supervision. This had to be balanced with the drivers for the platform providers, that were more interested in re-using that same data to provide value-added services. Hence, traditional business-to-government information sharing is transformed by creating new business models and changing the ways companies collaborate. In this way platforms increase the information quality and compliance but also contribute to transparency, facilitation of economic growth and information provisioning by governments. The platforms can thus also transform the way in which public values are better warranted and realized.

6.4. Contribution to theory

This paper presents two in-depth cases that reveal challenges and instruments for transformation through platforms. They allow for moving the thinking on platforms in the domain on e-government forward, providing new connections among existing concepts, and exploring the practical implications of these connections. Our synthesis of the literature indicated two focus areas along which the platform concept can be analyzed and enriched: the information infrastructure and the governance. As we have only explored a subset of the themes, challenges and instruments based on two cases, the paper reveals several areas for further theoretical exploration. These include the generic types of instruments (the left column in Table 3) that may be used for classification and as an analytical lens to study other efforts that use external developments and collaborative platforms to transform business-to-government information exchange, or government operations in general. Also, as the selection of two cases in different contexts presents a limitation of this research, more empirical and comparative research should be performed to be able to make claims on how outside-in transformations should be conducted and what governance arrangements are conducive to actual transformation and adoption of platform by both sectors.

7. Conclusions

Platforms form an inclusive vehicle for public–private collaboration and outside-in transformation. They are attractive because they integrate horizontally (between interacting organizations) and vertically (shared services for multiple government agencies), providing benefits for both business and government agencies. Platform governance rights are allocated to both public and private parties. Nevertheless, government agencies keep a relatively high level of control to secure public values and at the same time businesses become responsible for securing these public values and encouraging innovation. Striking a balance between autonomy and control, finding business models that align with public sector interests, and setting up a collaborative process to select and adopt standards and infrastructure components are vital ingredients to making the transformation work. Both cases discussed in this paper provide examples of collaborative platform governance. Such governance is able to combine the interest of businesses and society, enabling outside-in transformation by capitalizing on external developments and leveraging private sector innovations. However, several challenges need to be addressed before transformation through platforms can be realized. These challenges range from providing the right incentives for businesses to co-develop and use a platform, standardization of data definitions and system-interfaces, to allocating decision-rights in the public–private governance structure. Through policy instruments such as agenda setting, business model creation, benefit redistribution, level playing field creation, standardization and as a last resort, subsidization, government agencies can help to collaboratively shape the development and adoption of platforms. However, fulfilling this role requires in-depth understanding of the information infrastructure components and potential instruments by policy makers, which is not an easy task since infrastructure components include inter-organizational process models, data elements and message specifications, service oriented architectures and information security considerations. Only a combination of instruments targeted at the situation at hand can be effective. A condition is that all parties are aware of and acknowledge the potential advantages. Only then an outside-inside approach to transformation can be taken. Not only involvement, but also pressure of businesses is necessary to shape the platform in the right direction. In this way the platform is adapted to the needs of both public and private organizations.

In light of these challenges, too much attention to the information infrastructure against too little attention to the public–private governance structure will frustrate and delay transformation efforts. Once the public–private governance structure is settled and accepted by the stakeholders that will be impacted by the transformation, the information infrastructure may evolve relatively quickly in platform-enabled transformation initiatives.

Acknowledgments

This work is part of the research project “Governing public–private information infrastructures”, which is financed by the Netherlands Organisation for Scientific Research (NWO) as Veni grant 451-13-020. Furthermore, the International Trade case was part of the CASSANDRA project, funded by the European Commission as part of the 7th Framework Programme (FP7; SEC-2010.3.2-1) under grant agreement no. 261795. The SBR case was part of the SBR program, an initiative by the Dutch government, in collaboration with the private sector.

References

- Arendsen, R., Peters, O., Ter Hedde, M.J., & Van Dijk, J.A.G.M. (2014). Does e-government reduce the administrative burden on businesses? An assessment of business-to-government systems usage in the Netherlands. *Government Information Quarterly*, 31(1), 160–169.
- Baldwin, C., & Woodard, C. (2009). *The architecture of platforms: A unified view*. In A. Gawer (Ed.), *Platforms, markets and innovation* (pp. 19–44). London: Edward Elgar.

- Barringer, B.R., & Harrison, J.S. (2000). Walking a tightrope: Creating value through inter-organizational relationships. *Journal of Management*, 26(3), 367–403.
- Bergeron, B. (2003). *Essentials of XBRL financial reporting in the 21st century*. New Jersey: John Wiley & Sons.
- Bevir, M. (2013). *A very short introduction to governance*. Oxford: OUP.
- Bharosa, N., Van Wijk, R., De Winne, N., & Janssen, M. (2015). *Challenging the chain. Governing the automated exchange and processing of business information*. Amsterdam: IOS Press.
- Borins, S. (2014). *The Persistence of innovation in government*. Cambridge: Brookings Institution Press with Ash Center for Democratic Governance and Innovation.
- Braa, J., Hanseth, O., Heywood, A., Mohammed, W., & Shaw, V. (2007). Developing health information systems in developing countries: The flexible standards strategy. *MIS Quarterly*, 31, 381–402.
- Chen, Y.-C. (2012). A comparative study of e-government XBRL implementations: The potential of improving information transparency and efficiency. *Government Information Quarterly*, 29(4), 553–563.
- Chesbrough, H.W. (2003). The era of open innovation. *MIT Sloan Management Review*, 44(9), 1–9.
- Cusumano, M.A. (2005). Google: What it is and what it is not. *Communications of the ACM*, 48(2), 15–17.
- De Bruijn, J.A., Ten Heuvelhof, E.F., & In't Veld, R.J. (2010). *Process management: Why project management fails in complex decision making processes* (2nd ed.). Berlin Heidelberg: Springer.
- De Reuver, M., Stein, S., & Hampe, F. (2013). From e-participation to mobile participation: Designing a service platform and business model for mobile participation. *Information Policy*, 18(1), 57–73.
- Debreceay, R., Felden, C., Ochocki, B., & Piechocki, M. (2009). *XBRL for interactive data: Engineering the information value chain*. Berlin: Springer.
- Eaton, B.D. (2012). *The dynamics of digital platform innovation: Unfolding the paradox of control and generativity in Apple's iOS*. (PhD) London: London School of Economics.
- Gal, U. (2008). *Boundary matters: The dynamics of boundary objects, information infrastructures, and organisational identities*. (PhD) Cape Western Reserve University.
- Gawer, A. (2009). Platforms, markets and innovation: An introduction. In A. Gawer (Ed.), *Platforms, markets and innovation* (pp. 1–16). Cheltenham: Edward Elgar Publishing.
- Gawer, A. (2014). Bridging differing perspectives on technological platforms: Toward an integrative framework. *Research Policy*, 43(7), 1239–1249.
- Gawer, A., & Cusumano, M. (2013). Industry platforms and ecosystem innovation. *Journal of Product Innovation Management*, 31(3).
- Hagiu, A., & Wright, J. (2011). *Multi-sided platforms*. (Working Paper) Cambridge: Harvard Business School.
- Hanseth, O., & Lyytinen, K. (2010). Design theory for dynamic complexity in information infrastructures: The case of building internet. *Journal of Information Technology*, 25, 1–19.
- Hesketh, D. (2010). Weaknesses in the supply chain: Who packed the box? *World Customs Journal*, 4(2), 3–20.
- Hofman, W., & Aldewereld, H. (2014). *CASSANDRA IT synthesis and integration (project deliverable D3.6)*.
- Inauen, M., & Schenker-Wicki, A. (2011). The impact of outside-in open innovation on innovation performance. *European Journal of Innovation Management*, 14(4), 496–520.
- Irani, Z., Elliman, T., & Jackson, P. (2007). Electronic transformation of government in the UK: A research agenda. *European Journal of Information Systems*, 16(4), 327–335.
- Janowski, T. (2015). Digital government evolution: From transformation to contextualization. *Government Information Quarterly*, 32, 221–236.
- Janssen, M., & Estevez, E. (2013). Lean government and platform-based governance—Doing more with less. *Government Information Quarterly*, 30(Suppl. 1), S1–S8.
- Janssen, M., Kuk, G., & Wagenaar, R.W. (2008). A survey of web-based business models for e-government in the Netherlands. *Government Information Quarterly*, 25(2), 202–220.
- Janssen, M., Chun, S.-A., & Gil-Garcia, J.R. (2009). Building the next generation of digital government infrastructures. *Government Information Quarterly*, 26(2), 233–237.
- Johnston, J., & Gudergan, S.P. (2007). Governance of public-private partnerships: Lessons learnt from an Australian case? *International Review of Administrative Sciences*, 73(4), 569–582.
- Klievink, B. (2011). *Unravelling interdependence: Coordinating public-private service networks*. Delft: Delft University of Technology.
- Klievink, B., & Janssen, M. (2014). Developing multi-layer information infrastructures: Advancing social innovation through public-private governance. *Information Systems Management*, 31, 240–249.
- Klievink, B., Van Stijn, E., Hesketh, D., Aldewereld, H., Overbeek, S., Heijmann, F., & Tan, Y.-H. (2012). Enhancing visibility in international supply chains: The data pipeline concept. *International Journal of Electronic Government Research*, 8(4), 14–33.
- Lynn, L., Heinrich, C., & Hill, C. (2000). Studying governance and public management: Challenges and prospects. *Journal of Public Administration Research and Theory*, 10(2), 233–261.
- Markus, L., & Bui, Q. (2012). Going concerns: The governance of interorganizational coordination hubs. *Journal of Management Information Systems*, 28(4), 163–197.
- Müller-Wickop, N., Schultz, M., & Nüttgens, M. (2013). XBRL: Impacts, issues and future research directions. In F. Rabhi, & P. Gomber (Eds.), *Enterprise applications and services in the finance industry*, vol. 135. (pp. 112–130). Springer.
- National Audit Office (2008). *The administrative burdens reduction programme*. London: The Stationery Office.
- Nielsen, P., & Aanestad, M. (2006). Control devolution as information infrastructure design strategy: A case study of a content service platform for mobile phones in Norway. *Journal of Information Technology*, 21, 185–194.
- Oliver, C. (1990). Determinants of interorganizational relationships: Integration and future directions. *Academy of Management Review*, 15(2), 241–265.
- O'Reilly, M., & Kiyimba, N. (2015). *Advanced qualitative research: A guide to using theory*. London: Sage Publications Ltd.
- Osterwalder, A., & Pigneur, Y. (2010). *Business model generation: A handbook for visionaries, game changers, and challengers*. New York: Wiley.
- Pinsker, R. (2003). XBRL awareness in auditing: A sleeping giant? *Managerial Auditing Journal*, 18(9), 732–736.
- Pollitt, C., & Bouckaert, G. (2004). *Public management reform: A comparative analysis* (2nd ed.). Oxford: Oxford University Press.
- Provan, K.G., & Kenis, P. (2007). Modes of network governance: Structure, management, and effectiveness. *Journal of Public Administration Research and Theory*, 18(2), 229–252.
- Sein, M., Henfridsson, O., Purao, S., Rossi, M., & Lindgren, R. (2011). Action design research. *MIS Quarterly*, 35(1), 37–56.
- Slaviero, C., Maciel, C., Alencar, F., Santana, E., & Souza, P. (2010). Designing a platform to facilitate the development of virtual e-participation environments. *Paper presented at the ICEGOV '10 Proceedings of the 4th International Conference on Theory and Practice of Electronic Governance*, Beijing, China.
- Accelerating global supply chains with IT-innovation. Tan, Y.-H., Bjørn-Andersen, N., Klein, S., & Rukanova, B. (Eds.). (2011). *ITAIDE tools and methods*. Berlin: Springer.
- Tilson, D., Lyytinen, K., & Sørensen, C. (2010). Digital infrastructures: The missing IS research agenda. *Information Systems Research*, 21(4), 748–759.
- Tiwana, A., Konsynski, B., & Bush, A. a. (2010). Research commentary —Platform evolution: Coevolution of platform architecture, governance, and environmental dynamics. *Information Systems Research*, 21(4), 675–687.
- Urciuoli, L., Hints, J., & Ahokas, J. (2013a). Drivers and barriers affecting usage of e-customs — A global survey with customs administrations using multivariate analysis techniques. *Government Information Quarterly*, 30(473–485).
- Urciuoli, L., Sternberg, H., Ekwall, D., & Nyquist, C. (2013b). Exploring security effects on transport performance. *International Journal of Shipping and Transport Logistics*, 5(3), 303–321.
- Van Veenstra, A.F. (2012). *IT-induced public sector transformation*. (PhD) Delft: Delft University of Technology.
- Van Veenstra, A.F., Klievink, B., & Janssen, M. (2011). Barriers and impediments to transformational government: Insights from literature and practice. *Electronic Government, An International Journal*, 8(2/3), 226–241.
- Von Tunzelmann, N. (2003). Historical coevolution of governance and technology in the industrial revolutions. *Structural Change and Economic Dynamics*, 14(4), 365–384.
- Weerakkody, V., & Dhillon, G. (2008). Moving from e-government to t-government: A study of process re-engineering challenges in a UK local authority perspective. *International Journal of Electronic Government Research*, 4(4), 1–16.
- Welch, E.W. (2012). The rise of participative technologies in government. In M.A. Shareef, N. Archer, Y.K. Dwivedi, A. Mishra, & S.K. Pandey (Eds.), *Transformational government through eGov practice: Socioeconomic, cultural, and technological issues*. Emerald Group Publishing Limited.

Bram Klievink is assistant professor at the Faculty of Technology, Policy and Management at Delft University of Technology, and head of the POLG (Policy, Organisation, Law & Gaming) group. He specializes in the governance of public-private information infrastructures and teaches in multiple courses and programs. Bram is working on several NWO and EU funded research projects. In 2013, the Netherlands Organisation for Scientific Research (NWO) awarded him a VENI grant. Address: Jaffalaan 5, 2628BX Delft, The Netherlands. Phone: +31 15 27 81131. E-mail address: a.j.klievink@tudelft.nl.

Nitesh Bharosa is a consultant at Thauris and holds a PhD in information systems from the Delft University of Technology. His specialties include Standard Business Reporting, XBRL, Lean Government and Compliance by design, Netcentric Information Orchestration, Enterprise Architectures and Information Quality and Crisis Management. Address: P.O. Box 95315, 2509CH The Hague, The Netherlands. Phone: +31 (0)70 820 96 60. E-mail address: n.bharosa@thauris.nl.

Yao-Hua Tan is professor of Information and Communication Technology at the ICT Group of the Department of Technology, Policy and Management of the Delft University of Technology. His research interests are service engineering and governance; ICT-enabled electronic negotiation and contracting; multi-agent modeling to develop automation of business procedures in international trade. Address: Jaffalaan 5, 2628BX Delft, The Netherlands. Phone: +31 15 27 88077. E-mail address: y.tan@tudelft.nl.