MASTER THESIS

Digitalisation of Customs compliance for companies operating globally: The Compliance Control Tower concept.

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ABSTRACT

Customs compliance matters in International trade. A majority of companies operating globally – up to 76% in the industrial products sector – have invested in Global Trade Management Software (GTMS) to have customs compliance in control and address the challenges brought by cross-border trade (Deloitte, 2017). However, many Customs & Trade executives of these companies report that they struggle to get the expected value from their GTMS implementation (Thomson Reuters & KPMG International, 2016). The misfit between what compliance practitioners have and what they need is not a recent phenomenon. After two decades which have seen unprecedented investments in the digitalisation of global trade processes (Hausman et al., 2010) and the gradual adoption of GTMS, compliance practitioners continue to face important difficulties to have customs compliance in control. Given the international trade challenges ahead and the impact of non-compliance on businesses (Ernst & Young LLP, 2006; Branch, 2009; Maurer et al., 2012) that misfit needs to be addressed. For decision-makers in charge of establishing roadmaps to improve the situation, the question of what digitalisation approach to adopt is critical. This thesis argues that this misfit has to do with the GTMS market structure, which makes it challenging, in particular for companies operating globally, to address the cross-cutting nature of the Customs compliance function. As a consequence, Multi-National Enterprises (MNEs) which have adopted a GTMS find themselves often with an additional 'silo' difficult to evolve and a Customs compliance function poorly digitalised. To address this issue, a change of paradigm is required: instead of trying to eliminate silos, e.g. by replacing or evolving GTMS implementations, the goal should be to connect them effectively and streamline interactions within the business ecosystem. To help achieve this objective, this thesis adopts a design science approach (Hevner et al., 2004) to lay the foundation of an innovative concept called Compliance Control Tower (CCT), which is examined through the Customs perspective (CCT-C). The CCT-C is meant to support the orchestration of the Customs compliance processes in real-time with all the stakeholders taking part in the business ecosystem. The CCT-C design pattern – the artefact of this research – is tested by means of a prototype submitted to expert reviews. This evaluation results in the CCT-C artefact to be scored relatively high in terms of potential to address the identified misfit. The thesis then concludes by offering possible avenues for extending the research topic in the future.

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When I started the Master program at the Rotterdam School of Management, it was not obvious how far I would go. Going back to school at the age of 51 while running a company and being the proud dad of five children is not an easy decision. This thesis represents the concretisation of three years of hard work, fascinating encounters, and the illustration that nothing is impossible.

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"To do things right, first you need love,

then technique."

Antoni Gaudí i Cornet (1852 - 1926)

Chapter 1 – Introduction

General Context

Customs compliance matters in International trade. A majority of companies operating globally – up to 76% in the industrial products sector have invested in Global Trade Management Software (GTMS) to have customs compliance in control and address the challenges brought by cross-border trade (Deloitte, 2017). Over the last two decades, the GTMS footprint initially focused on compliance has evolved to include logistics and trade finance (Joshi, R., 2011). Today, GTMS is often presented as (a suite of) tools designed to assimilate all of the processes & management strategies and disciplines needed to run and manage a global supply chain (Klappich, 2005). Hence, a GTMS is meant to interact with companies' Enterprise Resource Planning (ERP) systems and existing management applications as well as with some of the other actors involved in the trade process, including suppliers or customers, transportation providers, customs brokers, banks, etc. It is also meant to include updates from regulatory agencies, to provide a way to create all trade documents automatically, to match them with each other, and check their compliance to current regulations (Gillai & Vorburger, 2007).

However, many Customs & Trade executives of companies operating globally report that they struggle to get the expected value from their GTMS implementation (Thomson Reuters & KPMG International, 2016). When asked about the specific area of Customs compliance, those executives report the difficulties they have to interpret and communicate requirements across sites and countries, disparities in requirements between countries, complex and changing requirements with local government agencies, disparate systems and persistence of manual operations, and lack of automation. This shows a misfit between what trade professionals have and what they need. The term 'misfit' refers to a mismatch between the elements of the enterprise system and elements of the organisation utilising the system, ranging from minor inconveniences to critical deficiencies in functionality (Strong & Volkoff, 2010). Given the impact of non-compliance on businesses (Ernst & Young LLP, 2006; Branch, 2009) and the benefits expected from GTMS implementations (Hausman et al., 2010), the question of how this misfit could be overcome to bring greater alignment between systems and organisations is highly relevant.

The international context adds additional pressure to the resolution of this misfit. After two decades which have seen an unprecedented expansion of global trade and steady growth of exports, trade-related indicators signal a worrying trajectory for world trade based on global export orders and economic policy uncertainty (WTO, 2019). The background of tensions between China and the United States, the return of protectionism and tariff retaliation measures, the shifting monetary and fiscal policies, the on-going negotiations related to trade agreements (NAFTA, MERCOSUR, etc.), the uncertainty caused by Brexit, the threats caused by resource depletion and environmental degradation, and, more recently, the impact of Covid-19 outbreak on the world economy, have propelled Customs matters very high on the agenda of multinationals C-Suite executives. For all these reasons and more than ever before, there is a need to have Customs compliance in control.

Enterprises need to have consistent and automatic approaches for compliance management in place to handle the complexity and costs to comply within a framework of regulatory objectives (Elgammal et al. 2010). However, the apparent lack of efficiency of GTMS implementations to address this need put decision-makers in an awkward position when it comes to developing sustainable Customs compliance digitalisation roadmaps. For multinational enterprises (MNEs), i.e. enterprises producing goods or delivering services in more than one country (Eurostat glossary[1]), the challenge is even higher since the digitalisation of Customs compliance has to deal with the locational implications that their offshoring and outsourcing strategy have on the supply chain (Buckley & Ghauri, 2004; Kotabe & Mudambi, 2009).

Problem Statement

Despite the investments made by MNEs over the last two decades to equip their Trade Departments with GTMS solutions meant to provide the necessary control over Customs compliance operations, compliance practitioners continue to report that they cannot fulfil their mission efficiently (Ernst & Young LLP, 2006; Branch, 2009; Thomson Reuters & KPMG International, 2016; Deloitte, 2017). Taking the analogy of air traffic control, there is apparently a difficulty for MNEs to provide their compliance practitioners with the *control tower* function that GTMS implementations (and associated ERPs) are meant to deliver.

[1] Refer to https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Multinational_enterprise_(MNE)

That such a misfit between what compliance practitioners need and what they have remains unanswered is curious, to say the least. Usually, when a misfit remains unaddressed during such a long period, it may be because it does not really need to be addressed by organisations. During interviews, compliance practitioners may air their grievances associated with using the system to perform their individual job functions without regard to how their job duties integrate with others across the organisation (Maurer et al., 2012). Said differently, the identified misfit is not an actual one, but rather a perceived one. There is a perceived misfit in case some stakeholders in the implementing organisation want to change the system to make it fit the process – or the other way around – while this is not necessary to actually achieve the performance required (Van Beijsterveld & van Groenendaal, 2015). However, there is also the possibility that organisations acknowledge that the identified misfit is an actual one, but just decide to live with it as long as the risk level created by the misfit is deemed acceptable.

However, recent trends seem to indicate that those approaches, which look rather like 'burying one's head in the sand', are no longer tenable. The current context of international trade is radically different from the one occurring twenty years ago, at the time deregulation had the wind in its sails. The misfit reported by Compliance practitioners, assuming it is an actual one, can no longer be overlooked and should rather be seen as an opportunity for companies, in particular those operating globally, to gain in productivity and face the challenges ahead. As emphasised by Maurer et al. (2012), misfits may in fact be beneficial to the firm under conditions of high environmental turbulence. Furthermore, the changes implemented in response to these misfits can create digital options that provide the organisation with a wider repertoire of possible actions that can be undertaken in the future (Sambamurthy et al., 2003). The simple presence and identification of a misfit can serve as a catalyst for breaking an inertial pattern thus serving as an opportunity to not only overcome the existing misfit but also to address future misfits that have yet to be identified.

Traditionally, the resolution of actual misfits – case the GTMS (or the ERP) imposes an inefficient way of working or the required functionality is missing – can be achieved by either customising the GTMS (or the ERP system the GTMS interacts with, or both) or by adapting the processes of the organisation to fit the requirements of the GTMS (Hong & Kim, 2002). Many studies (mostly on MNEs) advocate adjusting the processes of the organisation because customisation is risky, costly and reduces maintainability (Zach & Munkvold, 2011). Another often-used argument is that the 'off-the-shelf' solutions contain best practices (Gattiker & Goodhue, 2002) and that it is wise for a company to use these.

However, in the present situation, the credit that can be given to the best practices promoted by GTMS vendors is highly questionable, given the relatively negative feedback reported by compliance practitioners over time. Moreover, the term 'best practices' clearly is a value judgement influenced by a vendor's description of how a specific business process is to be performed in an optimal way based on working with previous customers; These are not general standards on how to run a business. (Holsapple et al., 2005; Ekman & Erixon, 2009).

In the light of those considerations, this thesis suggests that the resolution of this misfit requires a complete re-examination of the situation to clarify about the requirements that a 'control tower-like' implementation should actually cover to meet the needs of compliance practitioners and, ultimately, to propose a design artefact fulfilling these requirements. Given the exploratory nature of such re-examination, it is suggested that the proposed design artefact takes the form of a *design pattern* applying Enterprise Architecture best practices (ArchiMate, 2019) and laying the foundation of the *Compliance Control Tower (CCT)* concept as a significant outcome of this thesis. The interest of such formalisation is that it essentially documents the artefact in a generic template format so that it can be repeatedly applied (Arcitura, 2020).

The availability of such a CCT design pattern would be a major asset for the resolution of the identified misfit. Indeed, with this CCT design pattern at hand, it would then become possible to assess whether an existing (or planned) Information System complies with the key elements of the pattern or not. MNEs decision-makers in charge of establishing digitalisation roadmaps for their organisation would then be able to consider digitalisation options driven by the resolution of the identified gaps. It is anticipated that such an approach would allow reducing the risk that the chosen digitalisation option does not produce the expected effect in terms of providing compliance practitioners with the necessary control over their Customs compliance operations. This latter point is likely to open the field for future research.

Research Question

Based on the problem statement formulated above, the thesis is driven by the following overarching research question:

> What artefact would remedy the inability of MNEs Information Systems (IS) to provide compliance practitioners with the necessary control over their customs compliance operations?

The answer to this question requires to proceed with a literature review (cf. Chapter 2), to establish a sound research strategy (cf. Chapter 3), to assess the relevance of the problem (cf. Chapter 4), and to derive the requirements leading to the design of the research artefact (cf. Chapter 5) and its evaluation (cf. Chapter 6). The identification of the requirements establishing the design foundation of the artefact requires some research activities to be conducted. Those activities allow answering to several sub-questions, each one contributing to the treatment of the overarching research question.

The first activity is to assess compliance practices in the specific context of MNEs, thus leading to the following sub-question:

> a) What are the issues encountered by MNEs' Compliance practitioners?

The second activity is to make an assessment of the Customs Compliance function, which is a key requirement to clarify the notion of *necessary control* over Customs compliance operations. Hence, the following sub-question:

> b) What are the characteristics of the Customs compliance function?

The third activity is to perform a GMTS market review to better understand its structure and identify key players. Hence, the following sub-question:

> c) What is the current GTMS market structure?

All findings emerging from these activities are expected to form the list of high-level requirements that the design artefact shall meet.

Search process and references

The desk research conducted for this thesis makes intensive use of electronic research databases (such as Proquest, EBSCO, Emerald, ScienceDirect, WileyInterscience, and ACM Digital Library) to identify research articles focused on the main constructs in scope, namely the *Customs Compliance*, the *MNEs context*, and the *digitalisation approach*.

Among the keywords that were used to conduct the literature review (either individually or combined together by means of logical operators such as AND, OR), it is worthwhile to mention: Customs, Compliance, Supply Chain, Multi-National Enterprise, Digitalisation, Global Trade Management, ERP, platforms, Business Process, Ecosystem, Control Tower, Integration, Social Media, Federation, Data Sharing, Collaboration, and Governance.

The vast majority of research articles that are referenced by this thesis are peer-reviewed articles that were published within the last ten years. Those articles are mostly published in the following journals: Journal of Enterprise Information Management, Business Process Management Journal, International Journal of e-Collaboration, Journal of Industrial Ecology, Journal of International Business Studies, Journal of Supply Chain Management, International Journal of Logistics Management, Journal of Electronic Government Research, Journal of Theoretical and Applied Electronic Commerce Research, Journal of International Management, Journal of Manufacturing Technology Management, International Journal of Productivity and Performance Management, International Journal of Operations & Production Management, and Journal of Business and Industrial Marketing.

Besides those research articles, several books published in specialised editions (e.g. Elsevier), as well as studies or white papers produced by consulting firms of reference (e.g. Gartner, Deloitte, KPMG, Ernst & Young), have also been considered. Finally, the desk research has been complemented by means of Google Search, specifically to investigate the GTMS market. The full list of reference materials used for this thesis is provided at the end of this document.

Structure of the thesis

The structure of the thesis is meant to flow with ease while establishing a consistent progression towards the design of the proposed artefact. To do so, it considers seven chapters as follows:

Chapter 1 – Introduction is an introduction to the thesis with the description of the general context into which it takes place followed by the formulation of the problem statement, the formulation of the overarching research question and related sub-questions, and the description of the search process.

Chapter 2 – Literature review is a critical summary of the research on the digitalisation of Customs Compliance in the context of companies operating globally. It identifies the gap in the literature that is the focus of this thesis.

Chapter 3 – Research Strategy presents the rationale for the research activity, the choice of the methodology and how it applies to the research object, the user participation to the design, the key drivers of the design, and the approach to the artefact design and evaluation.

Chapter 4 – Assessment of Problem Relevance is a research activity, which aims at assessing the relevance of the problem and producing the requirements establishing the foundation of the design artefact.

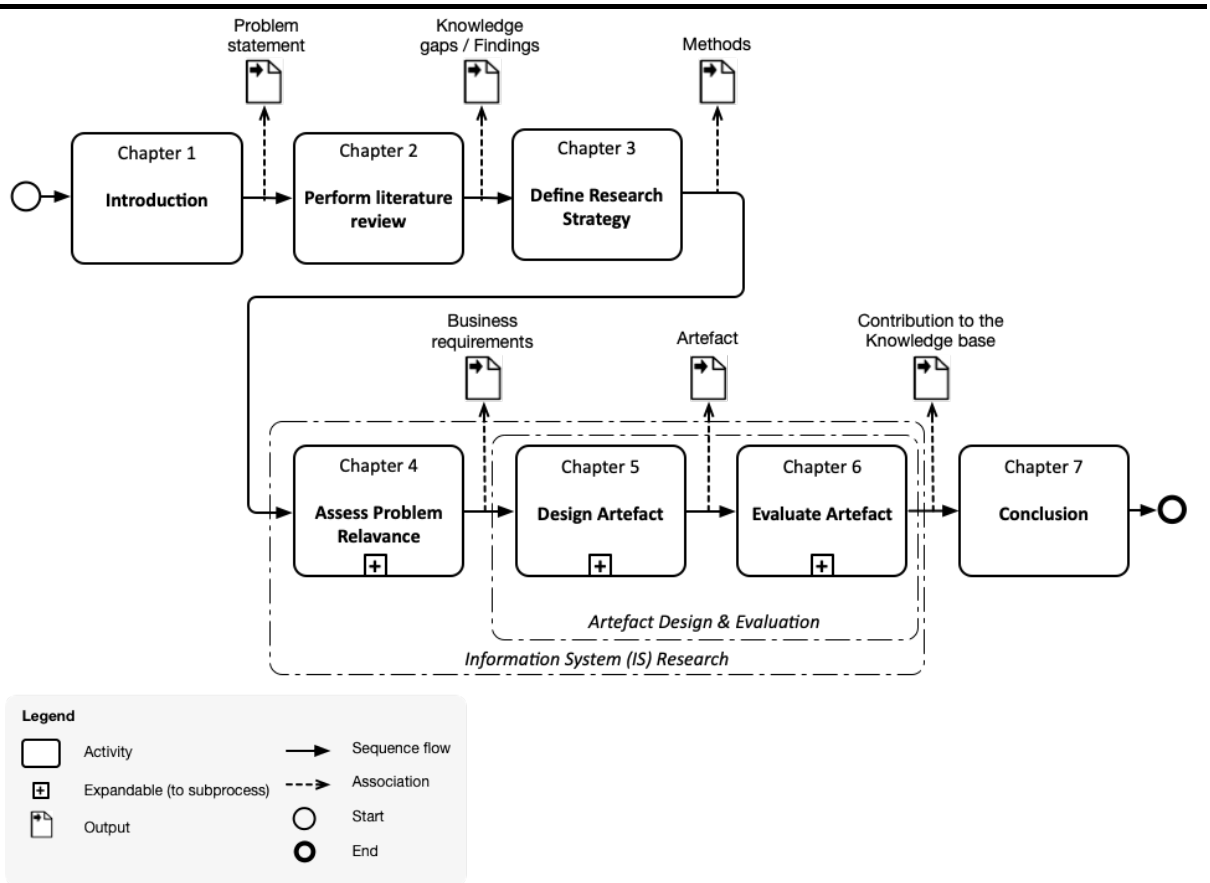
Chapter 5 – Artefact Design provides the design of the research artefact – namely the Compliance Control Tower (CCT) design pattern.

Chapter 6 – Evaluation focuses on the method used to evaluate the artefact along with the results of the evaluation process.

Chapter 7 – Conclusion summarises the main findings of the research, and presents some limitations of the proposed artefact and opportunities for future work.

The logic behind the chaining of those chapters and their respective output is described in Figure 1.

Figure 1: Structure of the thesis - Logical chaining of Chapters (BPMN notation).



Chapter 2 – Literature review

About Customs compliance

There is an abundance of academic literature on *compliance* when considered in its general assertion. Governatori (2005) defines *compliance* as an act or process to ensure that business operations, processes, and practices are in accordance with prescriptive – often legal – documents. Sadiq et al. (2007) further elaborate on this definition to demonstrate that a sustainable approach for achieving compliance should fundamentally have a preventative focus (also known as *compliance by design*) aiming at facilitating the propagation of compliance requirements into business process models and enterprise applications. McIntyre (2008) defines compliance as the desired outcome, with regard to law and regulations, internal policies and procedures, and commitment to stakeholders that can be consistently achieved through managed investment of time and resources. Veenstra, (2019) highlights that compliance can also be introduced on a voluntary basis via corporate social responsibility schemes (e.g. to ban child labour), which may also result in companies imposing rules on other companies.

The literature, however, is relatively scarce when the emphasis is placed on the specific area of *Customs compliance*. Actually, the academic literature does not give any definition for *Customs compliance,* and this terminology is often used as if it was talking by itself. Very often, elements of Customs compliance have to be derived from contributions, which are focused on related areas such compliance management strategies (Governatori & Sadiq, 2009; Burgemeestre et al. 2011), regulatory compliance management (Elgammal et al. 2010; El Kharbili, 2012; Boella et al., 2013; Jiang et al., 2014), compliance enforcement (Tallberg, 2002), business process compliance (Gong et al. 2017; Hashmi et al. 2018), compliance by design (Olivieri, 2014), compliance cost model (Arsyida et al., 2017; Rose, 2017), supply chain visibility & governance (Aberdeen Group, 2006; Tan et al. 2011, In et al. 2018, Veenstra, 2019), e-government (Gil-Garcia et al. 2007), data quality (WCO, 2015), and data sharing & infrastructures (Henningson & Henriksen, 2011; Overbeek et al. 2011; Klievink et al. 2012; Bharosa et al. 2013; Rukanova et al. 2018).

However, those contributions do not say much about Customs compliance seen as a *strategy element* (Archimate, 2019) of the enterprise. Likewise, except for the review performed by Keer (2009), very little is said about Customs compliance seen as a *Business Function* taking part in the operational organisation of an enterprise. Finally, the literature does not provide a holistic view of the business processes – i.e. the sequence of business behaviours that achieves a specific result (Archimate, 2019) – pertaining to Customs compliance, in particular when seen from the trader side.

About companies operating globally

Companies operating globally or Multi-National Enterprises (MNEs) – both are synonyms (Eurostat glossary) – are subject to an abundance of research activities and many different fields. Doing an exhaustive review of those fields would not bring much to this thesis and, therefore, the focus has been put on aspects which are relevant when connected to Customs compliance and digitalisation, so mainly organisational elements.

As an organisation, the MNE has an inherent tendency towards a federative structure (Ghoshal & Bartlett, 1990), in which subunits develop an autonomous knowledge base and thus a degree of strategic independence from the centre. In particular, subsidiaries develop 'embedded' relationships in (mostly local) business networks which significantly enhance their ability for strategic actions (Forsgren et al. 2005). However, this creates a tension between the MNE as a managerial hierarchy and the MNE as an organisational structure. Arguably, the federative structure of the MNE has been unfavourable to managers, especially those in the top echelon of multinational headquarters. Their response is thus to limit the federative character of multi-nationality in various ways (Yamin & Sinkovics, 2010).

From an organisational viewpoint, subsidiaries in the multinational do not have authority-based or 'structural' power for key strategic decisions (Bacharach & Lawler, 1980; Brooke, 1984), but they benefit from 'resource-based power' in that they can exploit strategic knowledge advantages over their headquarters. Subsidiaries benefit from capabilities to the extent that their proximity to the host markets is of value to the multinational as a whole (Buckley & Ghauri, 2004). Business network analysis highlights the 'invisibility' to the MNE's upper echelons of the external networks (often in the host country) through which valuable subsidiary knowledge – such as knowledge of local trade & customs regulatory frameworks – and capabilities develop and points out that this 'invisibility' undermines the headquarters' ability to control the subsidiary (Krackhardt, 1990; Andersson & Forsgren, 1996; Forsgren et al. 1995; Holm & Johanson, 1995; Yamin & Sinkovics, 2007; Wu, 2008).

As a reaction to this loss of control, the digitalisation (specifically the implementation of ERP software) contributes to a significant shift in coordination and control issues in MNE–subsidiary relationships, as demonstrated by Yamin & Sinkovics (2010) through their empirical explorations. The introduction of ERP (e.g. SAP) is, in one sense, a movement back to 'big computing', i.e. a much more centralised approach towards ICT configurations and architecture. While the MNE has traditionally evolved from a unitary organisation with replica subsidiaries (thus leading to federative structures), it has increasingly moved back again towards centralised structures ('flagship' MNEs, see Rugman & D'Cruz, 2003).

Despite ERP implementations, a widely encountered characteristic of MNEs is their complexity at all levels and, in particular the high complexity of their IT infrastructure, which most of the time suffers from a very high heterogeneity. This heterogeneity is characterised by a myriad of IT systems making use of different technologies inherited from past IT generations or being the consequence of the organisation has grown through acquisitions of smaller entities using different technologies and platforms. These insular structures (or 'silos') restrict the flow of information, which makes it hard to manage and adapt to change (Satell, 2017).

Faced with this problem, it should not be a surprise that IT managers try to break silos whenever they can. This also explains why so many MNEs have invested very significant amounts of money in the 'rationalization' of their IT infrastructure, e.g. to replace their disconnected, legacy ERPs by a brand new one (Kaniadakis, 2012). However, very often those investments do not really bring the expected value in return in the way that the complexity and the heterogeneity remain very high together with maintenance costs. The problem is that when a company takes the initiative of breaking down silos, it inevitably creates others (Satell, 2017).

This trend creates additional challenges to compliance linked to the locational implications of offshoring and outsourcing strategy. In particular, logistics, inventory management, distance, nationalism, and a lack of working knowledge about foreign business practices, among others, are major operational problems encountered by multinational firms engaging in global sourcing (Kotabe & Mudambi, 2009).

Moreover, driven by economic liberalisation and technological developments, supply chains become more complex and fragmented considering the decentralisation of production, marketing and distribution activities worldwide (Sardar & Lee, 2015). Due to local trade procedures, policies, regulations and cultures, a supply chain that comprehends an international dimension faces several issues concerning cross-border logistics and transportation, before reaching the final customer (Higginson, 2013; Sardar & Lee, 2015; Veenstra, 2019). One adversity is that a company planning to off-shore manufacturing activities is exposed to higher compliance risks in comparison to a company dealing only with intra-regional businesses (Kumar et al. 2009). Enterprises operating globally are under pressure to comply with an increasing number of external regulations imposed by various governmental authorities (zur Muehlen et al., 2007).

This situation has led MNEs to adapt their internal structure to reach a higher level of performance. Depending on the level of performance at stake, i.e. whether it concerns getting higher control, or better adaptability to change, or better knowledge sharing, or better coordination, etc., these structures may evolve in completely different ways (i.e. functional, divisional, matrix, transnational, projects) (Johnson et al., 2014). In this context, the challenge put on MNEs' trade departments is very high as they have to fit into the global structure of their organisation but also to design and adjust their business processes to ensure they operate properly within the boundaries delineated by local (governmental) regulations (Jiang et al., 2015).

However, the literature does not provide any standard operating model (focused on management, processes organisation, and technology) that MNEs' trade departments could apply to deliver on the organisation strategy and quite an important research field remains open to fill this gap[2]. Moreover, the fact that there is no single structure characterising the organisation of MNEs but rather a multiplicity of structures not necessarily compatible to each other is an aspect to be taken in consideration in the artefact design process.

[2] Cf. Master thesis written by Mrs Isabel Hanot, Executive Master in Customs and Supply Chain Management - 2017-20. *Rotterdam School of Management - Erasmus University.*

About the Control Tower concept

Because the design artefact developed within the framework of this thesis is meant as a control tower-enabling component, it makes sense to investigate what the literature tells about the *Control Tower* concept.

The immediate observation is that the term *Control Tower* means many things to many people, which already constitutes a major challenge. Initially meant as a *tall building at an airport from which the movements of air traffic are controlled* (Oxford English Dictionary), the term Control Tower has been offering an excellent analogy to many domains to express a combination of people and technology managing time-phased inbound and outbound flows. This perhaps explains why the Control Tower terminology is largely used in the industry. However, except the case analysis realised by Trzuskawska-Grzesińska (2017), no research publications focused on describing the Control Tower concept could be found in the academic literature.

Transportation – movement and flow of goods from one place to the other via ground, air, and sea – was first to adopt the control tower terminology in its operations, a couple of decades ago. The usage of this terminology has then been extended to other disciplines such as manufacturing, warehousing, and distribution, so ultimately to the whole domain of Supply Chain Management (SCM)[3].

The term Control Tower is also used interchangeably with other words, including *control room*, *war room*, *command centre*, and *mission control*. At the core, all of these constructs are similar since their fundamental objective is *to control a process to effect an outcome* (Thomas, 2020).

The term control tower is also more and more present in IT vendors presentations (e.g. Damco, E2open), usually connected with the promise that a control tower will make the supply chain better, faster and smarter, and often presented as the '*Artificial Intelligence of the Supply Chain*'. In these presentations, the term Control Tower is systematically associated with the term Supply Chain, thus forming the *Supply Chain Control Tower* construct. There is, however, no uniform market description of what a Control Tower solution actually is, or what measurable benefits it actually brings; moreover there are no standardised requirements or obligatory capabilities (Titze, 2020).

In an attempt to establish some fundamentals, Gartner defines a *Control Tower as a concept combining five elements – people, process, data and organisation supported by a set of technology-enabled capabilities for transparency and coordination*. After studying various business cases, Trzuskawska-Grzesińska (2017) defines the Control Tower as *the planning and execution system that effectively deals with resource constraint and/or contention as well as process deviation in order to execute corrective and preventive actions in real-time. Its purpose is to regulate the supply chain by maximising service, minimising cycle time, while optimising resources*.

Control towers are becoming more and more popular because they are marketed as the solution for stitching together complex and siloed supply chains, thus providing more visibility and insights into the overall performance. Buyers hope for more transparency and better coordination that will ultimately result in lower costs and higher efficiency (Titze, 2020). Ideally, a control tower utilises data to create insights and enables its users to make smarter decisions. It is the entry point for all relevant people with a supply chain mandate, which also makes it the starting point for all decision-making. A control tower monitors, measures and reports timing, efficiency and service data in real-time and it assists the customer in aligning and realising strategic objectives (Greene & Caragher, 2015). Moreover, according to Titze (2020), a good control tower should allow its users to:

- Sense: Get real-time, end-to-end supply chain visibility;
- Analyse: Understand and leverage incoming signals;
- Predict: Utilise advanced analytics for predictions and prescriptions;
- Solve: Do exception management and scenario modelling;
- Execute: Leverage a collaborative intelligent response framework;
- Learn: Continuously learn, sense and respond.

[3] The Council of Supply Chain Management Professionals (CSCM 2016) defines the Supply Chain Management (SCM) as the discipline which encompasses the planning, organising and controlling all activities involved in sourcing and procurement, conversion, and all logistics activities. It also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third party service providers, and customers. In essence, supply chain management integrates and balances supply and demand within and across companies.

The value matrix established by Lippincott (2019) shows that, as customers are looking for greater visibility of their extended value chains, traditional GTMS vendors (such as SAP GTS[4], Infor[5], E2open[6]) are trying to answer the call by shifting their solutions where the promise of Control Tower for the autonomous supply chain is realised. These vendors have moved their solution from merely delivering a view of customer's operations for planning or execution purposes to provide more orchestration and insights based on consolidated data generated by the entire value chain. New players (such as Kinaxis[7], One Network[8], Elemica[9], Blue Yonder[10], MP Objects[11]) also use the Control Tower pattern as an entry point to offer extended functionality in SCM planning and execution.

However, the Customer's ability to manage change is often the biggest limiting factor for the adoption of those solutions (Lippincott, 2019). As a consequence, the market of control tower solutions continues to remain fragmented with many vendors finding success in industry verticals and specialising in particular SCM areas such as planning, execution, order management, and logistics (Lippincott, 2019). However, compliance aspects remain widely uncovered by existing Control Tower solutions and nowhere could be found anything valuable meant as a control tower specialised in the field of compliance.

About digitalisation

Very often in literature, the confusion is made between *digitisation*, *digitalisation*, and *digital transformation* (Bloomberg, 2018). According to Gartner's IT Glossary (2019), digitisation is the process of changing from analogic to digital form, also known as digital enablement. Said another way, digitisation takes an analogic process and changes it to a digital form without any different-in-kind changes to the process itself.

Unlike digitisation, digitalisation does not have a single clear definition. Variants coexist whether one refers to *social life* - namely a way in which many domains of social life are restructured around digital communications and media infrastructures (Musik & Bogner, 2019), to *business models* – namely the use of digital technologies to change a business model and provide new revenues and value-producing opportunities (Gartner's IT Glossary (2019), or to *processes* – namely the action to automate information processes among employees internally so that the engagements between channel members and customers are as informed as possible (Crittenden et al. 2019), and more generally, to *the action to employ digital technologies and information to transform business operations* (Muro et al. 2017). Digitalisation, however, is quite distinct from digital transformation. An organisation might undertake a series of digitalisation projects, ranging from automating processes, reshaping its digital presence, to retraining workers to use computers. Digitalisation is commonly acknowledged as an opportunity to make productivity gains, to develop new business, or to improve current operations (Schwab, 2016). Digitalisation has an important impact on organisational performance (Guo et al. 2017), and it has significance as a source for value creation (Amit & Zott, 2001).

Digital transformation, in contrast, is not something that enterprises can implement as projects. Instead, Bloomberg (2018) defines the digital transformation as the customer-driven strategic business transformation that requires cross-cutting organisational change as well as the implementation of digital technologies. So, in summary, we digitise information, we digitalise processes and roles that make up the operations of a business, and as a result, we digitally transform the business.

Rukanova et al. (2018), in the search for explanations and solutions for effective digitalisation, portrays the digital infrastructure development challenge as two-fold. One part of the challenge originates in the inertia of the installed base. The installed base refers to the pre-existing components of the digital infrastructure that constitute the starting point for any development attempt; these include existing work practices, human resources, standards, technological artefacts – in the present case GMTS and ERPs – and organisational commitments (Hanseth et al., 1996, Monteiro & Hanseth, 1996, Ciborra & Hanseth, 2000). Since in the development process it is rarely possible to redesign the digital infrastructure from scratch, development always '*wrestles with the inertia of*

[4] Cf. SAP GTS '*Global Trade Services*' – https://www.sap.com/belgie/products/global-trade-management.html
[5] Cf. Infor '*Digitally transform and optimize your supply chain network end-to-end*' – https://bit.ly/2WoEwkz
[6] Cf. E2open '*Global Trade Management Intelligent Application Suite Profile*' – https://bit.ly/2CG6jWF
[7] Cf. Kinaxis '*Supply Chain Planning Software Solution*' – https://www.kinaxis.com/en
[8] Cf. One Network '*The Sentient Business Network*' – https://www.onenetwork.com/
[9] Cf. Elemica '*Transform Supply Chains*' – https://elemica.com/
[10] Cf. Blue Yonder '*Leading Supply Chain Platform*' – https://blueyonder.com/
[11] Cf. MP Objects '*Supply Chain Orchestration Software*' – https://www.mpo.com/

the installed base and inherits strengths and limitations from that base' (Ciborra & Hanseth, 2000 (p. 113). Inertia to change may come from technical elements, human habits and social norms that are resistant to transformation (Edwards et al. 2007) and this limits the direction of a development trajectory (Hanseth & Lyytinen, 2010, Henningsson & Hanseth, 2011, Henfridsson & Bygstad, 2013).

Digitalisation is key to an understanding of the business and industrial movements of the 21st century. The contention is that digitalisation will have a significant impact on both the structure and the operations of the business world, on the business models and on how companies cope with increasing competition, slimmer margins for productivity and profitability and more pronounced requirements for effective planning, problem-solving and decision making (Carlsson, 2017). The HBR report Competing in 2020 shows that Artificial Intelligence (AI) and machine learning appear as key interests and concerns among the business leaders; the formulation is that *future success will depend on the successful collaboration between human and machine intelligence*. The concern is that artificial intelligence and automation will eliminate jobs in some industries (financial services, professional / business services). Digitalisation is bringing big data/fast data which is claimed to make it impossible to use analytics as huge amounts of data make the algorithms impossible or impractical to use – or it will take too much time – as fast decision making in almost real-time is a necessity in the digital economy ("the fast eat the slow" as the slogan goes).

Bottom line

The literature review indicates that the digitalisation of Customs compliance in the context of companies operating globally remains a subject widely uncovered by the literature, whether academic or professional. While companies operating globally are under pressure to comply with an increasing number of external regulations imposed by various governmental authorities, very little is documented about Customs compliance seen from the trader side.

This situation represents an important knowledge gap that needs to be addressed prior to considering digitalisation aspects. Therefore, an essential part of the research work conducted within the framework of this thesis will be focused on the analysis of the Customs compliance function. The literature review also reveals a number of findings that the research strategy (cf. Chapter 3 – Research Strategy) can highly benefit from:

- The observation that the Customs compliance function remains widely undocumented indicates that an *exploratory design* should preferably be conducted to answer the research question. Indeed, an exploratory design is conducted about a research problem when there are few or no earlier studies to refer to. The focus is on gaining insights and familiarity for later investigation or undertaken when problems are in a preliminary stage of investigation. Moreover, exploratory research is flexible to address research questions of all types (what, why, how), and provide an opportunity to define new concepts (Cuthill, 2002).
- The observation that there is no single structure characterising the organisation of MNEs but rather a multiplicity of structures not necessarily compatible to each other is clearly an aspect to be taken in consideration in the artefact design process. More specifically, it indicates that the design process should seek for a certain degree of generalisation even if exploratory design usually inhibits the ability to generalise to the whole population at large. The literature review of the context of companies operating globally seems, therefore, to confirm the validity of the initial intention (expressed in the problem statement) to formalise the artefact of the research as a *design pattern* (Arcitura, 2020) so as to find the right balance between specialisation and generalisation.
- The observation that compliance aspects remain widely uncovered by existing Control Tower solutions (which focus rather on transport and logistics aspects) emphasizes the interest to fill this gap and, therefore, to come into play with a design pattern of a control tower specialised in the field of compliance, in short, a *Compliance Control Tower (CCT) design pattern*.
- The observation that digitalisation of Customs compliance (eventually by the means of a Compliance Control Tower) always wrestles with the inertia of the installed base and inherits strengths and limitations from that base, indicates that specific attention shall be given to the analysis of the existing environment. For this thesis, this should take the form of an assessment of the problem relevance and in-depth analysis of the MNE's business context and GTMS market structure (cf. Chapter 4).

Based on those findings, it is now possible to define the research strategy adopted by this thesis, which is the subject of the next chapter.

Chapter 3 – Research Strategy

Introduction

The research strategy is discussed in this chapter. It details how the proposed artefact – the *Compliance Control Tower (CCT)* – is developed and evaluated. As stated previously, the goal of this research work is to develop an artefact able to address the misfit reported by practitioners of multinationals making use of a GTMS in terms of lack of adequacy between what practitioners need and what they have to conduct their daily compliance operations. Based on the finding of the literature review (cf. Chapter 2), which advocates for conducting an exploratory design, the choice is made to use a *design science research* methodology to answer the overarching research question of this thesis. This latter point is developed hereafter.

Choice of the Methodology

The *research methodology* is defined as the philosophy of a research process that includes the assumptions and values that serve as a rationale for research and the standards or criteria the researcher uses for interpreting data and reaching a conclusion (Basili, Selby & Hutchens, 1986). Basically, a research methodology applies a scientific method to solve a research problem (answer a research question). When trying to decide which research methodology to apply, the approach has been to consider methodologies that are frequently used in Information Systems (IS).

According to March & Smith (1995), there are two distinct paradigms of research in IS: *behavioural science* and *design science*. The research methodology used in this thesis is the *design science* (Hevner et al., 2004) because the goal is to design a new artefact – namely the CCT – for designing information systems. While routine design is the application of existing knowledge to organisational problems, design science involves finding new solutions to previously unsolved problems or better and more efficient solutions to previously solved problems (March & Smith, 1995).

In order to standardise all design representations (diagrams, architectures, etc.) and ease their validation by IS field experts, the choice is made to take advantage of the Archimate® specifications, which provides a set of entities and relationships with their corresponding iconography for the representation of architecture descriptions. This point is further developed hereafter (cf. Key drivers of the design). Moreover, the Business Process Model and Notation (BPMN) is used for process descriptions (including for describing the process of writing this thesis) so as to standardize their semantics and ease their communication to a large audience.

Figure 2: Information System (IS) research framework adapted from Hevner et al. 2004, p.80.

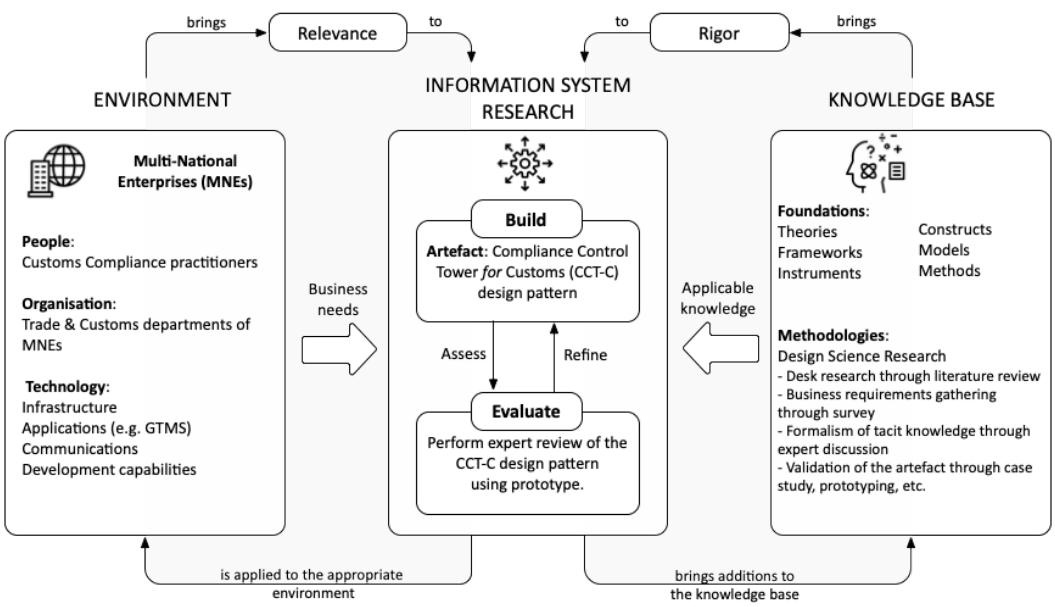


Figure 2 describes the research framework used for this research. It clearly shows the process through which the knowledge base and the environment respectively bring rigour and relevance to the IS research, and through which the produced design artefact is applied to the environment and enriches the knowledge base.

Design Science Methodology applied to the Artefact

According to Hevner et al. (2004), effective design research must provide a clear contribution to the areas of design artefacts, design construction knowledge, and/or design evaluation methodologies. To help achieve this goal, Hevner et al. (2004) provide a framework for research activities in design science within the IS discipline and a clear set of (7) guidelines or principles for conducting and evaluating good design science research. The following section describes how those guidelines are actually applied to this research.

1. Design as an Artefact

There is one clear artefact produced by this research: the Compliance Control Tower (CCT) design pattern (and its instantiation for the Customs area (CCT-C)) The artefact is created by analysing the business requirements of Compliance practitioners that traditional GTMS-based approach fails to answer, by analysing the structure of the GTMS markets to understand about its strengths and limitations, and by deriving from all this research the design requirements of the artefact.

2. Problem Relevance

From Chapter 2 - Literature review, it is evident that the digitalisation of Customs compliance in the context of companies operating globally is a domain widely uncovered by the knowledge base. To verify the problem's relevance, a qualitative survey is conducted at several MNEs on the need for enhanced IS capabilities. The survey questionnaire is drafted based on a previous study conducted by Thomson Reuters & KPMG International (2016) that it contributes to actualise. The objective is to better understand the issues that compliance practitioners (making use of a GTMS) report they have, hence to assess whether the problem statement is relevant (or not).

3. Design Evaluation

The utility, quality and efficiency of a design artefact must be rigorously demonstrated through a well-executed evaluation method. As Hevner et al. (2004) point out, evaluation is a crucial component of the research process. A design artefact is complete and effective when it satisfies the requirements and constraints of the problem it was meant to solve. The evaluation of design artefacts typically uses methodologies available in the knowledge base. Evaluation methods such as observation, analytical, experimental, testing, and descriptive methods can be used. In the thesis, the method chosen for the evaluation of the artefact is to gather expert reviews of compliance practitioners by the means of a prototype implementing the artefact and a feedback questionnaire. Details of the evaluation process are discussed in the section Evaluation of artefact and also in Chapter 6 – Evaluation.

4. Research Contribution

Effective design science research must provide clear contributions in the areas of the design artefact and design construction knowledge, such as foundation, or design evaluation knowledge and methodologies. The ultimate assessment of any research is "*what are the new and interesting contributions?*" (Hevner et al., 2004). This thesis contributes to the different levels of design science research identified by Gregor & Jones (2007): an artefact (level 1), design principles (level 2), and an emergent design theory (level 3). Full details are presented in Chapter 5 – Artefact Design. Therefore, the outcomes of this thesis can be seen as a valuable addition to the knowledge base which can be classified as middle-range theory, as we generalize beyond a particular case but within a specific context (Ketokivi & Choi, 2016) – namely companies operating globally.

5. Research Rigor

Rigour in design research relates to the way in which research is conducted. Design science requires the application of rigorous methods in both the construction and evaluation of the design artefact (Hevner et al., 2004). This thesis has theoretical foundations in the field of Enterprise Architecture (EA). The design process is developed from a thorough search and review of the relevant literature and the identification of knowledge gaps (cf. Chapter 2 – Literature review). To address these gaps, multidisciplinary design principles (Brown, 2009) are used to develop the artefact (cf. Chapter 5 – Artefact Design). The new artefact is instantiated through a prototyping activity (conducted in parallel to the thesis writing). The evaluation of the artefact is done rigorously using expert reviews.

6. Design as a Search Process

Design is essentially a search process to discover an effective solution to a problem. Problem-solving can be viewed as utilising available means to reach desired ends while satisfying laws existing in the environment (Simon, 1996). Design science research has traditionally not drawn on theories from the design discipline because it focuses on theory as a set of practices to be followed when building an artefact, while traditional IS design theories (also known as *utility theories*) provide guidelines or principles for designers to ensure their artefact meets its goals. In this thesis, the utility theories which were used for the development of the artefact are essentially the *Pattern Theory* and *User-Centred Design (UCD)*.

The Pattern Theory, introduced in the '70s, provides a theoretical setting for a large number of ideas, techniques and results from fields such as computer vision, speech recognition, pattern recognition, image processing, and parts of Artificial Intelligence (AI) (Knill & Richards, 1996). Pattern theory provides a formalism to describe the knowledge of the world in terms of patterns. The IT community embraced the pattern vision for its relevance to problems that had long plagued software design in general and service-oriented design in particular. This explains why Pattern Theory has become one of the most widely used and important ideas of the past decade in software architecture and design (cf. Archimate® as an Enterprise Architecture (EA) design framework).

User-Centred Design (UCD) is the process of designing a tool, such as a website or an application user interface, from the perspective of how it will be understood and used by a user (Garrett, 2002). UCD approaches the task of problem-solving by seeking to understand end-users' needs, aspirations and goals, and the environmental conditions and constraints in which they live. In UCD projects, designers consult users about their needs and involve them at specific times during the design process, typically during requirements gathering and usability testing. UCD is a multidisciplinary design approach based on1) the active involvement of users to improve the designers' understanding of users and their task requirements, and 2) the iteration of design and evaluation. It is widely considered the key to product usefulness and usability, and *an effective approach for overcoming the limitations of traditional system-centred design*" (Mao et al., 2005, p. 105).

7. Communication of Research

Design science research must be presented both for technology-oriented and management-oriented audiences (Hevner et al., 2004). Technology-oriented audiences need sufficient detail to envisage the implementation described artefact, while management-oriented audiences need sufficient detail to determine if organisational resources should be committed to building and using the artefact within their specific organisational context. This thesis clearly addresses both audience types and adopts a didactic approach from general to specific with many contextual explanations, thus allowing that none of the readers gets lost in transit.

User Participation in the Design Process and Evaluation

The concept of the *user* is fundamental in the research and practice of IS design, development and evaluation. Lack of communication between users and developers has been a common theme in the well-documented reasons for failures in IS implementations (Bussen & Myers, 1997). Moreover, user involvement is likely to result in increased user satisfaction and the perceived usefulness of the artefact (Terry & Standing, 2004). When transposed to the problem statement of this thesis – which is about addressing the misfit reported by compliance practitioners making use of a GTMS –, it seems obvious that user involvement in the artefact design and evaluation process is essential. As Dray & Seigel (2007) suggest, there is a great need for design to be driven by a deep understanding of users, and their activity patterns, processes, and external influences from society. Furthermore, a deep understanding of users and their mental models can influence specific design decisions, such as the affordances of new products, and may lead to the creation of different and innovative services or products (Dray & Seigel, 2007). For all these reasons, the choice that is made to involve compliance practitioners as early as possible in the process. This choice is instantiated by the involvement of a set of practitioners in the assessment of the problem relevance (Chapter 4) through their contribution to a qualitative survey. Moreover, these same practitioners are also involved in the evaluation of the design artefact (Chapter 6), which they contribute to improve and align with their expectations by the means of expert reviews.

Key drivers of the design

1. Archimate® as an Enterprise Architecture (EA) design framework

There is no simple answer to the problem statement of this thesis as it relates to many elements of the enterprise from both the business and IT side. An Enterprise Architecture (EA) is typically developed because key people have concerns that need to be addressed by the business and IT systems within an organisation. Such people are commonly referred to as the *stakeholders* of the Enterprise Architecture. The role of the architect is to address these concerns by identifying and refining the motivation and strategy expressed by stakeholders, developing an architecture, and creating views of the architecture that show how it addresses and balances stakeholder concerns. Without an Enterprise Architecture, it is unlikely that all concerns and requirements are considered and addressed.

The design of the proposed artefact (cf. Chapter 5 – Design Process) being essentially an EA-driven initiative, it is essential that rigour and consistency be brought to all representations. To achieve this goal, the choice made for this thesis is to use the ArchiMate® Enterprise Architecture design framework, which is a reference in this field.

The ArchiMate® Enterprise Architecture modelling language provides a uniform representation for diagrams that describe Enterprise Architectures. It includes concepts for specifying inter-related architectures, specific viewpoints for selected stakeholders, and language customization mechanisms. It offers an integrated architectural approach that describes and visualizes different architecture domains and their underlying relations and dependencies. Its language framework provides a structuring mechanism for architecture domains, layers, and aspects. It distinguishes between the model elements and their notation, to allow for varied, stakeholder-oriented depictions of architecture information. The language uses service-orientation to distinguish and relate the Business, Application, and Technology Layers of Enterprise Architectures and uses realization relationships to relate concrete elements to more abstract elements across these layers. It therefore strongly helps formalise new *design patterns* – such as the CCT design pattern – themselves being the composition of existing ones or composed by larger ones.

> *A design pattern describes a common problem and provides a corresponding solution. It essentially documents the solution in a generic template format so that it can be repeatedly applied. Knowledge of design patterns not only arms you with an understanding of the potential problems designs may be subjected to, it provides answers as to how these problems are best dealt with. Design patterns are described according to a profile structure including parts such as the addressed requirement & problem, the solution & its application, the impacts & relationships, etc. Design patterns can be further combined into compound patterns that solve larger problems. Design patterns refer to specific service-orientation design principles and levels of Service Oriented Architecture* (Arcitura, 2020).

2. Business ecosystem as an actionable construct for the artefact design

As highlighted during the literature review, there is no single structure characterising the organisation of a company operating globally, but rather a multiplicity of structures each one answering to a strategic vision of the company. This explains why some companies seeking for strong control have evolved towards a functional organisation while those seeking more flexibility have rather evolved towards matrix or transnational organisation (Johnson et al., 2014). However, when it comes to defining a design pattern meant to be generalizable to any organisation type, there is a need to envision the company organisation with a higher level of abstraction. This thesis argues that the concept of a *business ecosystem* can advantageously serve this objective. Indeed, Moore (1996) defines the business ecosystem as

> *an economic community supported by a foundation of interacting organisations and individuals – the organisms of the business world. This economic community produces goods and services of value to customers, who are themselves members of the ecosystem. The member organisms also include suppliers, lead producers, competitors, and other stakeholders. Over time, they coevolve their capabilities and roles, and tend to align themselves with the direction set by one or more central companies. Those companies holding leadership roles may change over time, but the function of ecosystem leader is valued by the community because it enables members to move toward shared visions to align their investments, and to find mutually supportive roles.*

Clearly, this definition of a business ecosystem offers an actionable construct to characterise the environment into which this research takes place – i.e. companies operating globally – while not limiting to a specific organisation

type, or size, or location. Moreover, the business ecosystem construct offers a nice opportunity to analyse the Customs compliance function through the perspective of an economic community including multiple (internal and external) parties (cf. Assessment of the Customs Compliance Function), thus stepping outside the (sometimes narrow) framework of the enterprise (Rong et al., 2017).

3. Data Pipeline as an actionable construct for the artefact deployment

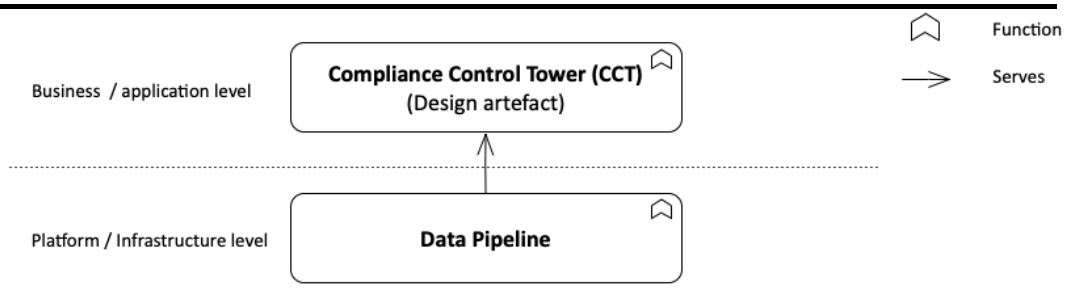
The artefact of this research is essentially meant as *practice enabler* focused on improving Customs compliance operations. So, clearly the scope of the research is situated at the business/application level. However, this does not mean that infrastructure aspects have to be completely ignored by the research. The reason is that the design of today's business applications is heavily dependent on the type of digital platforms onto which applications/services are deployed.

According to EA best practices, a design artefact built according to the Service Oriented Architecture (SOA) principles[12] is likely to offer higher characteristics in terms of flexibility, portability, and reusability, provided that the deployment infrastructure adopts similar SOA principles itself.

For that reason, this thesis argues that the design artefact should be meant to be deployed on any platform falling into the concept of *Data Pipeline*. Indeed, Klievink et al. (2012) define the data pipeline as *a concept based on the use of Service-Oriented Architectures (SOA) to enable access to the existing information systems that are used and operated by the various parties in global supply chains. The data pipeline is a virtual bus, created by linking the companies enterprise systems (where e.g., data on purchase orders, invoices, and packing lists originate from), inter-organisational systems connecting parties such as freight forwarders and shipping lines, and systems for tracking, tracing and monitoring the goods (Overbeek et al., 2011). The data pipeline provides one integrated access point to the different sets of information that already exists fragmented throughout the supply chain and is held in the different types of documents. The data pipeline is intended as a federated IT solution; the data remains with the individual companies that are responsible for it. Clever linking of data through data references creates an integrated data view* (Klievink et al.,2012).

So clearly, the data pipeline concept fits nicely to serve the 'clever linking' realised at business level by the proposed design artefact, as illustrated in Figure 3.

Figure 3: Data Pipeline as an actionable construct for the artefact deployment (Archimate Notation)



Evaluation of artefact

After being designed, the artefact needs to be evaluated. Indeed, according to Hevner et al. (2004), evaluation is a crucial component of the research process. Moreover, the goodness and efficacy of an artefact can be rigorously demonstrated via well-selected evaluation methods (Basili, 1996; Kleindorfer et al., 1998; Zelkowitz and Wallace

[12] There are 9 design principles to keep in mind when designing a SOA service (source Arcitura, SOA Principles of Service Design, https://www.arcitura.com/book/soa-principles-of-service-design/):

1. Standardized Service Contract: Services adhere to a service-description.
2. Loose Coupling: Services minimize dependencies on each other.
3. Service Abstraction: Services hide the logic they encapsulate from the outside world.
4. Service Reusability: Logic is divided into services with the intent of maximizing reuse.
5. Service Autonomy: Services should have control over the logic they encapsulate.
6. Service Statelessness: Ideally, services should be stateless.
7. Service Discoverability: Services can be discovered (usually in a service registry).
8. Service Composability: Services break big problems into little problems.
9. Service Interoperability: Services should use standards that allow diverse subscribers to use the service.

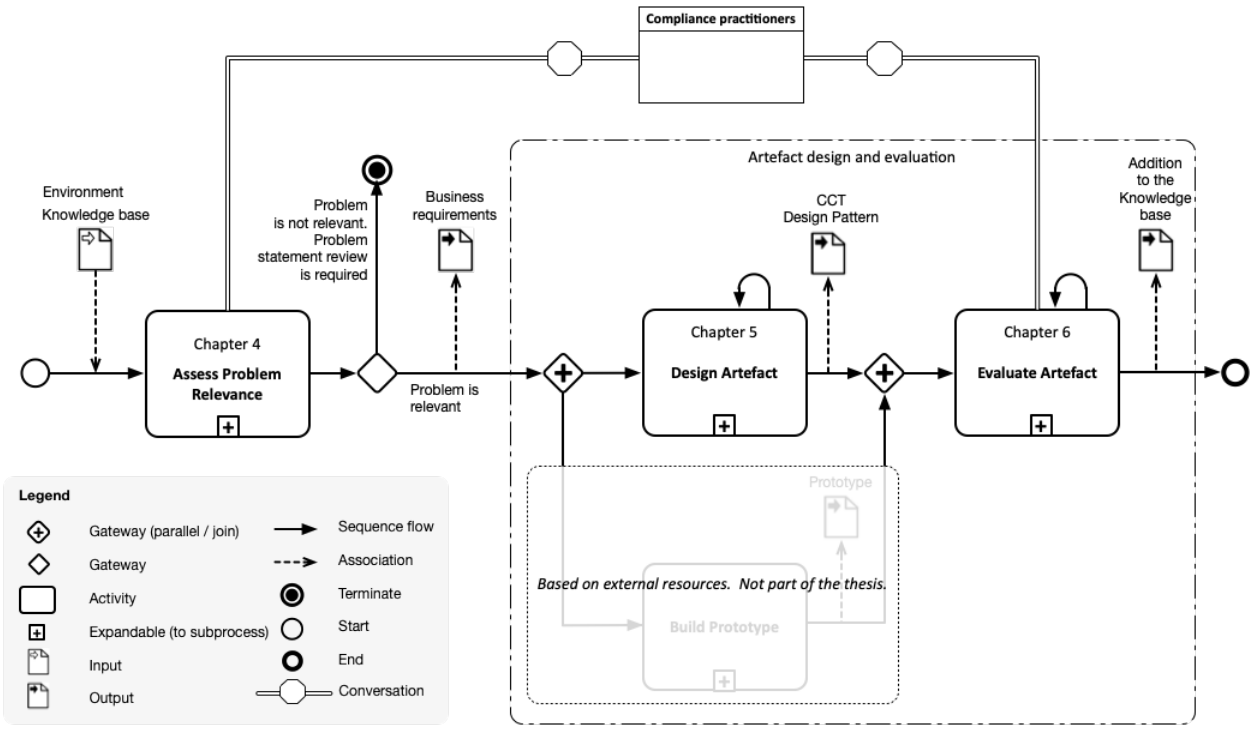
1998). Hevner et al. (2004) give five evaluation methods: observational, analytical, experimental, testing, and descriptive.

Given the innovative nature of the proposed artefact, an experimental method essentially based on prototyping is chosen for evaluation. The main purpose of the prototype is to demonstrate that the proposed artefact can lead to a consistent implementation that would potentially allow addressing the problem statement. This prototyping activity is also complemented by an expert review and a case study.

Overall Process

The overall process resulting from the chosen research strategy is illustrated in Figure 4.

Figure 4: Overall process of the artefact design and evaluation as derived from the Hevner et al. 2004 guidelines (BPMN notation).



Bottom line

This chapter has allowed the identification of the *design science* as a suitable approach for this research project, as the focus is on the construction of an artefact. Hevner et al. (2004) research framework and guiding principles are fully used for that purpose. The relevance of the problem statement is assessed by the means of a qualitative survey conducted at several MNES. The instantiation of the proposed artefact – the CCT – is done through prototyping and the artefact is evaluated by the means of expert reviews.

Chapter 4 – Assessment of the Problem Relevance

Introduction

To assess the relevance of the problem it is required to make an in-depth analysis of the research environment. Indeed, as mentioned by Hevner et al. (2004), the artefact of the research cannot be conceived as independent of people or the organisational and social extents in which it is used, but as interdependent and coequal with them in meeting business needs. Given the nature of the problem expressed above (cf. problem statement), which essentially reflects the difficulty that MNEs making use of a GTMS have to provide compliance practitioners with the necessary control over their Customs compliance operations, the research is focused on three key topics:

1. Assessment Customs compliance practices at several MNEs (survey), which goal is to get a better insight into the issues encountered by MNES practitioners and identify their business needs;
2. Assessment of the Customs Compliance Function, which goal is to have a better understanding of what this function actually encompasses and its intrinsic properties;
3. GTMS market review, which goal is to have a better understanding of the GMTS offering and market structure.

The expected outcome of these activities is twofold. First, it is to get the assurance whether the problem, as formulated above, is relevant (or not); Secondly, to serve as an input to the identification of the key requirements establishing the *design foundation* of the proposed artefact – namely the *CCT Design Pattern.*

Assessment of Customs compliance practices at several MNEs (survey)

Introduction

This part aims at answering the research sub-question a). To assess the view of compliance practitioners on the need for enhanced IS capabilities, a qualitative survey is conducted with a subset of MNEs representatives. This survey is inspired by the GTM survey report issued by Thomson Reuters & KPMG International (2016), which it contributes to actualise. The objective of this survey is to get a better insight of the issues encountered by MNEs representatives, to understand about their perception of the compliance risks, to offer them a way to express their business needs as well as their view of what should be done to improve the situation. The following sections provide a description of the survey participants, the list of questions that they were invited to answer, the analysis of the data that were collected, and the key findings of the survey.

Participants

The qualitative survey has been conducted with seven MNEs, all of them being randomly selected manufacturers evolving in various industries as listed in Table 1.

Table 1: Assessment of problem relevance - Participating MNEs to the qualitative survey.

Name	Sector	Headquarter	# of countries of operation	# of employees (world)	Annual revenue 2018 ($bn)	Forbes Global 2000 index (2019)
Company A	Mechanical and electrical engineering	Zürich (CH)	46	147.000	27,6	**282**
Company B	Chemical and consumer goods	Düsseldorf (DE)	72	53.000	23,1	**322**
Company C	Pharmaceuticals	Osaka (JP)	53	27.230	16,6	**377**
Company D	Tyre Manufacturer	Clermont-Ferrand (FR)	171	112.000	22	**394**
Company E	Consumer Media and Electronics (photography and imaging)	Tokyo (JP)	67	79.000	21,8	**522**
Company F	Automotive seating and automotive electrical systems	Southfield, MI (USA)	39	161.000	21,2	**884**
Company G	Healthcare Consumer Electronics	Kyoto (JP)	38	40.000	7,9	**1412**

In order to make sure that the chosen sample of MNEs is consistent with the subject in scope, each MNE meets a set of criteria in terms of size (> 25k employees), revenue (> $7bn), and geographical implantation (>30 countries). The intended audience is departmental-level representatives in charge of the Customs compliance function, all of them being located in the EU. This way, the survey ensures that each participant is qualified and has a sound understanding of the topics covered by the questionnaire. For confidentiality reasons, the company names are anonymised.

Questions

Because the survey is primarily focused on getting a better understanding about the misfit that is precedently reported by compliance practitioners making use of the GTMS (cf. Thomson Reuters & KPMG International, 2016), many questions are indeed exploring this topic (cf. Table 2). For convenience, the questions were published on-line[13] using the facilities offered by SurveyMonkey[14], which is a popular free online survey tool.

Table 2: Questions of the qualitative survey conducted at 7 MNEs.

Section 1 - Introduction	
Q1	Please select the industry sector of your multinational company
Q2	Please enter the name of your company (optional)
Q3	Indicate company (global) annual turnover
Q4	Please select the best description of your position
Q5	What department do you currently report into?
Q6	How many persons are dedicated to the Customs and Trade function? (fill both lines with a whole number)
Section 2 - The Customs compliance pain points your organisation is facing today	
Q7	Which among the items below would you consider as pain point(s) to the optimal execution of the Customs Compliance function in your department / organisation (multiple choice allowed)?
Section 3 - Perception of risks to the Customs compliance function	
Q8	Rate the following Customs-related activities in terms of how you perceive the risk for penalties, other government sanctions, or increased import costs. (one choice per row)
Section 4 - Usage of Global Trade Management Software (GTMS)	
Q9	Is your organisation using a Global Trade Management (GTM) system (such as SAP GTS, Amber Road, Descartes, etc.)?
Q10	Does the fact that the GTM system is used at regional / local level create consistency issues? (multiple choice allowed)
Q11	Which GTM system is used by your organisation? (multiple choice allowed)
Q12	What Customs Compliance activity is your department / organisation managing with its GTM system(s)? (multiple choice allowed)
Q13	How would you rate the Return on Investment (RoI) of your GTM implementation ? (optional)
Section 5 - Customs compliance without GTMS	
Q14	Which of the following manual processes is supplemented by the use of spreadsheets, (e.g. xls macros) or other basic data structures or email communications? (multiple answers allowed)
Q15	Would you say that manual processes restrict the speed and accuracy of customs and global trade compliance reporting?
Section 6 - Getting to the goal	
Q16	Which among the following items do you think would be required to address the Customs Compliance issues your department / organisation is facing? (one answer per line)
Section 7 - Closure	
Q17	Overall, how would rate your level of satisfaction with regards to the current level of digitalisation of Customs Compliance processes within your organisation?
Q18	Do you have any other comments, questions, or concerns?
Q19	Please enter your contact information if you would like to receive a copy of the Master Thesis once finalised (optional)

Data collection

The data have been collected during the January - March 2020 period by the means of the SurveyMonkey online data gathering facilities. The collected data were then exported to Excel® format for further analysis. The raw data collected during this period are provided in appendix A.

[13] Cf. on-line questionnaire published at https://bit.ly/3cLlSbG.
[14] https://www.surveymonkey.com/.

Data Analysis

To check for nominal agreement among the respondents, the data analysis makes use, when applicable, of the Fleiss' kappa, k, (Fleiss, 1971). Fleiss' kappa is a measure of inter-agreement used to determine the level of agreement between two or more raters when the method of assessment, known as the response variable, is measured on a categorical scale (such as for questions Q7, Q8, Q13, Q16, and Q17). In Table 4, Table 5 and Table 6, the individual Fleiss' kappa (ki) are simply Fleiss' kappa calculated for each of the categories of the response variable separately against all other categories combined. The p-value is also used to report whether the Fleiss' kappa is statistically significant (i.e. if the p-value is less than .05, the Fleiss' kappa coefficient is statistically significantly different from 0).

The following classifications (see Table 3) have been suggested for assessing how good the strength of agreement is when based on the value of the kappa coefficient. The guidelines below are from Altman & Bland (1999) and adapted from Landis & Koch (1977).

Table 3: Classification of kappa value based on Altman & Bland (1999), and adapted from Landis & Koch (1977).

k	Interpretation
< 0	Poor agreement
0,01 - 0,20	Slight agreement
0,21 - 0,40	Fair agreement
0,41 - 0,60	Moderate agreement
0,61 - 0,80	Substantial agreement
0,81 - 1,00	Almost perfect agreement

Analysis of the current pain points reported compliance practitioners

With a kappa value of .209 (min = .117, max = .273), the analysis shows that there is only a slight agreement between the consulted practitioners with regards to the issue types that they are facing when those issue types are taken as a whole (see Table 4). This indicates that the consulted MNEs trade departments are not facing one single pattern of issue types when running compliance operations, but rather a combination of issue types which differ from one company to another.

However, when each issue type is considered individually, the analysis shows that there is a fair to moderate agreement between the respondents on five top issue types, which are categorised as having a medium to very high (negative) impact on operations. Those issue types are 1. Difficulty to adapt to constantly changing rules and regulations (k_i = .522); 2. Insufficient visibility into corporate developments impacting Customs compliance (k_i = .426); 3. Budgetary constraints on compliance management (k_i = .331); 4. Lack of availability of reliable data (e.g. to fulfil declaration filing process, to do reporting, etc.) (k_i = .331) and 5. Current IT tooling does not effectively support compliance goals (k_i = .236). It is interesting to notice that this top 5 refers to issues that are of different nature i.e. organisational, financial, and IT-related.

Analysis of the perception of the risks associated with Customs compliance activities

When asked about their perception of the risks associated with Customs compliance activities (see Table 5), here again, there is only a slight agreement between the respondents (kappa = .174) when the risk types are considered as a whole. This means that the trade departments consulted do not have the same perception of the risks. However, when considered individually, a fair to moderate agreement seems to emerge around three top risks: 1. Import valuation (k_i = .426); 2. Export Controls (k_i = .331); and 3. Customs brokers management (k_i = .236).

Analysis of the way GTMS is used

When asked about whether their organisation is making use of a GTMS to support compliance operations, 85,72% of the respondents answer that it does, which is pretty much in line with what other studies are reporting (Deloitte, 2017). The GTMS products used are SAP GTS, E2OPEN (AmberRoad), Integration Point, and Descartes, which are among the major players on this market (see also the review of the GTMS Market for more details). However, there are important disparities in the way the GTMS is used.

Three organisations use it at global level – same GTMS (or group of GTMS) is used everywhere –, two organisations use it at regional level – various GTMS coexist on a per-region basis, but no real interconnections between regions –, and one organisation uses it at local (country) level – high heterogeneity of GTM systems, often working in 'silos'. For those organisations which make a regional or local usage of their GTMS, all of them confirm that important disparities between sites impact the smooth execution of Customs compliance operations. Two of them explain this issue by the fact that several GTMS are used in their organisation as a consequence of several merging/acquisitions and that the lack of integration between those GTMS makes it very hard to obtain global visibility on Customs Compliance processes. This point is indeed very much in line with the Top 5 issues reported above. Another interesting point that emerges from this survey is that the GTMS (whatever it used globally, regionally, or locally) seems to be used essentially for HS classification purpose but remains relatively unused to cover other key compliance activities such as supplier assessment, FTA certification of origin solicitation, customs valuation, and duty calculation.

Analysis of the business requirements expressed by compliance practitioners

With a kappa value of .41 (min = .321, max = .489), the analysis shows that there is a moderate agreement between the consulted practitioners on their business requirements (see Table 6). This seems to indicate that even if the consulted practitioners are not facing the same issue types (see Table 4), there is a general consensus on what should be done to be getting to the goal. It may sound strange at first, but in fact, looking at the data more closely, there is a logical explanation for it. Indeed, when considering the suggested measures individually (and not at a whole), there is a very substantial agreement (k_i = .71) among the respondents on the following three key measures: 1. Better data quality ('making the right data available at the right time to the right people'); 2. Customs compliance practitioners effectively assisted by digital tooling (e.g. control tower offering global visibility); 3. Record keeping and audit trails (historical transactional data) digitally managed. Interestingly, these top 3 measures all focus on data management and respondents' respective GTMS implementations appear to be ineffective in providing the necessary control over compliance data, mostly in terms of quality and visibility. Given the key importance of data – the 'fuel' of the Information System – this observation is not trivial. Overall, it indicates that the consulted practitioners consider that the answer to their respective compliance issues is essentially digital. There is also a moderate agreement ($.43 < k_i < .52$) on other measures which are organisational, among which can be mentioned the reduction in the number of external partners (e.g. brokers) and insourcing of the whole Customs Compliance function, the better organisation of the trade department, the increased management support, and the better interpretation and communication of Customs Compliance requirements across sites and countries.

Analysis of the overall level of satisfaction

When asked about rating their level of satisfaction on a 1-10 scale (1 - Very dissatisfied to 10 - Very satisfied) with regard to the current level of digitalisation of Customs Compliance processes within their respective organisations, all the respondents express their relative dissatisfaction with a weighted average of 3,86.

Findings of the assessment of Customs compliance practices

The qualitative survey conducted at seven MNEs, all of them being randomly selected manufacturers evolving in various industries, confirms that existing GTMS implementations do not optimally support compliance operations. There is a general agreement among the respondents that the misfit between what practitioners need and what they have is mainly due to the difficulty of existing GTMS (and associated ERP) implementations to ensure proper management of compliance data. That difficulty has apparently to do with the intrinsic nature of the Customs compliance function, which imposes to adapt to constantly changing rules and regulations (k_i = .522) and to interact with multiple stakeholders. This difficulty manifests itself in the form of a lack of availability of reliable data required to conduct their operations. The issue therefore not only about getting better visibility on compliance data but also a better data quality. In most of the cases, GTMS are used partially (e.g. to perform product classification), which may explain the relative dissatisfaction expressed by the respondents about the level of digitalisation of the Customs compliance processes. Customs practitioners also highlight the need for a better organisation of the Customs compliance management, taking into account the locational implications that the offshoring and outsourcing strategy of their organisation have on their daily activity. Overall, this indicates a need for a business-driven transformation putting Customs compliance practices at the heart of the digitalisation process.

Table 4: Identifying main issues encountered by compliance practitioners (Q7) - Kappa value for all measures.

	Very low impact on operations	Low	Medium	High	Very high impact on operations	k_i
1 Difficulty to adapt to constantly changing rules and regulations	0,00%	0,00%	71,43%	28,57%	0,00%	**0,522**
2 Insufficient visibility into corporate developments impacting Customs	0,00%	0,00%	57,14%	42,86%	0,00%	**0,426**
3 Budgetary constraints on compliance management	0,00%	0,00%	57,14%	28,57%	14,29%	**0,331**
4 Lack of availability of reliable data (e.g. to fulfil declaration filing process, to do reporting, etc.)	0,00%	0,00%	14,29%	57,14%	28,57%	**0,331**
5 Current IT tooling does not effectively support compliance goals	0,00%	0,00%	28,57%	42,86%	28,57%	**0,236**
6 Lack of senior management or local management buy-in and support	0,00%	42,86%	0,00%	57,14%	0,00%	0,426
7 Lack of desired skills/expertise with import/export compliance functions	0,00%	42,86%	0,00%	42,86%	14,29%	0,284
8 Insufficient internal controls (policies procedures, training, etc.)	0,00%	28,57%	28,57%	42,86%	0,00%	0,236
9 Lack of awareness and/or inability to influence corporate decisions	0,00%	28,57%	42,86%	28,57%	0,00%	0,236
10 Not being in control due to many operations being outsourced (e.g. to	0,00%	28,57%	42,86%	28,57%	0,00%	0,236
11 Insufficient headcount assigned to Customs compliance activities	0,00%	14,29%	14,29%	28,57%	42,86%	0,189

m	7
n	11
Pa	0,3160
Pe	0,1350
kappa (k)	**0,209**
s.e	0,041
z	5,120
p-value	3,1E-07
alpha	0,05
lower	0,1292
upper	0,2894

Table 5: Perception of the risks associated with Customs compliance activities (Q8) - Kappa value for all measures.

	Very low risk on operations	Low	Medium	High	Very high risk on operations	k_i
1 Import valuation	0,00%	0,00%	57,14%	0,00%	42,86%	**0,426**
2 Export controls (dual use, restricted party screening)	0,00%	0,00%	57,14%	14,29%	28,57%	**0,331**
3 Customs broker management	0,00%	28,57%	42,86%	28,57%	0,00%	**0,236**
4 Inter-company transfer prices	0,00%	42,86%	28,57%	0,00%	28,57%	0,236
5 Supply chain security	14,29%	42,86%	28,57%	14,29%	0,00%	0,189
6 Product import classification	0,00%	14,29%	28,57%	28,57%	28,57%	0,141
7 Free trade agreements	0,00%	28,57%	28,57%	28,57%	14,29%	0,141
8 Import documentation and licensing	14,29%	14,29%	14,29%	42,86%	14,29%	0,140
9 Free trade zone	28,57%	57,14%	14,29%	0,00%	0,00%	0,331
10 Global transportation management	0,00%	42,86%	57,14%	0,00%	0,00%	0,426
11 Temporary import	14,29%	71,43%	14,29%	0,00%	0,00%	0,474

m	7
n	11
Pa	0,281
Pe	0,130
kappa (k)	**0,174**
s.e	0,037
z	4,75
p-value	2E-06
alpha	0,05
lower	0,102
upper	0,246

Table 6: Addressing Customs compliance misfits (Q16) - Kappa value for all measures.

		Must have (Non-negotiable requirements that is mandatory for the correct execution of the function)	**Should have** (Important requirement that is not vital, but adds a significant value)	**Could have** (Nice to have, but small impact if left out)	**Won't have** (not a priority for the moment)	k_i		
1	Better data quality ('making the right data available at the right time to the right people')	85,71%	14,29%	0,00%	0,00%	**0,71**	m	7
2	Customs compliance practitioners effectively assisted by digital tooling (e.g. control tower offering global visibility)	85,72%	14,29%	0,00%	0,00%	**0,71**	n	15
3	Record keeping and audit trails (historical transactional data) digitally managed	85,72%	14,29%	0,00%	0,00%	**0,71**	Pa	0,476
4	Reduction in the number of a external partners (e.g. brokers) and insourcing of the whole Customs Compliance function	28,57%	71,43%	0,00%	0,00%	0,52	pe	0,119
5	Better organisation of the Customs & Trade Department	71,43%	14,29%	14,29%	0,00%	0,48		
6	Increased management support	71,43%	14,29%	14,29%	0,00%	0,48	**kappa (k)**	**0,41**
7	Better interpretation and communication of Customs Compliance requirements across sites and countries	71,43%	14,29%	14,29%	0,00%	0,48	s.e	0,04
8	Reliance of multiple external partners (e.g. brokers, 3PLs) as long as the global visibility on their operation is ensured.	14,29%	71,43%	14,29%	0,00%	0,48	z	9,43
9	Support from external experts / consultants	0,00%	71,43%	14,29%	14,29%	0,48	p-value	0,00
10	All actors of the supply chains (suppliers, carriers, 3PLs) aligned to Customs Compliance objectives and practices	57,15%	42,86%	0,00%	0,00%	0,43		
11	Customs Compliance activities consistently applied across all sites and countries	42,86%	57,14%	0,00%	0,00%	0,43	alpha	0,05
12	Additional training of Customs Compliance practitioners	28,57%	57,14%	14,29%	0,00%	0,33	lower	0,321
13	Flexible adaptation to complex and changing requirements of local Customs authorities	57,14%	14,29%	14,29%	14,29%	0,28	upper	0,489
14	More headcount dedicated to Customs Compliance tasks	57,14%	14,29%	14,29%	14,29%	0,28		
15	Increased visibility on external partners activities (e.g. brokers)	57,15%	28,57%	14,29%	0,00%	0,33		

Assessment of the Customs Compliance Function

Introduction

This part aims at answering the research sub-question b). The literature review has highlighted the lack of academic knowledge about the Customs compliance function, in particular when adopting the trader-side perspective. A better understanding of this function is however required as a prerequisite to further design activity. In light of the above survey, it is essential to clarify the content of the *necessary control over compliance operations* that the Customs compliance function is meant to provide. It is also needed to examine the interactions with the business ecosystem of the enterprise that the Customs compliance function requires.

To achieve this objective, a research activity essentially based on professional literature and field expertise is conducted. This outcome of this research is presented hereafter. It is meant to contribute to fill some knowledge gap in this field and to participate in the identification of the business requirements establishing the foundation of the design artefact.

Customs Compliance

Definition

As mentioned earlier, the literature does not give an academic definition for *Customs compliance*. However, it clearly appears from the literature (Governatori, 2005; Sadiq et al., 2007; McIntyre, 2008; Veenstra, 2019) that compliance connects two distinct domains: the *regulatory domain* and the *business process domain*. The two domains differ from each other in their specificities and their objectives. Essentially, the regulatory domain is *prescriptive* in nature; it ascribes conditions that details which actions can be considered legitimate, and which actions must have refrained while executing a business process. In contrast, the business process domain is more *descriptive* detailing how business processes are executed to carry out business objectives (Hashmi et al. 2018). Based on the above, this thesis suggests that *Customs compliance* should be defined as follows:

> *Customs compliance is a form of compliance meeting the regulatory and process requirements that govern the movement of commercial goods crossing the borders of Customs territories*[15].

Customs compliance Elementary Business Functions

To go deeper into the analysis of the Customs compliance function, it is required to identify the collection of business behaviours (or practices) closely aligned to the organisation that allows for the smooth execution of the function. Those business behaviours are called *Elementary Business Functions (EBF)* as per the Archimate terminology. These elementary functions allow achieving Customs compliance practices at the various stages of the global trade and supply chain lifecycle. Each elementary function may trigger the execution of one or several *business processes*.

> *A business process represents a sequence of business behaviours that achieves a specific result such as a defined set of products or business services. There is a potential many-to-many relationship between business processes and business functions. Informally speaking, processes describe some kind of "flow" of activities, whereas functions group activities according to required skills, knowledge, resources, etc.* (Archimate, 2019)

To identify those Elementary Business Functions, the research on trade and compliance cost model in the international supply chain (Arsyida et al., 2017) provides an interesting source of inspiration. Indeed, the model proposed in this research note establishes a typology of compliance costs supported by the company at different stages of the compliance process (initial set-up and approval, transaction, inspection, post-clearance).

The thesis reuses this approach to produce a functional model adopting a slightly different terminology (inspired by Reekmans & Simoens, 2010) offering a higher degree of generalisation.

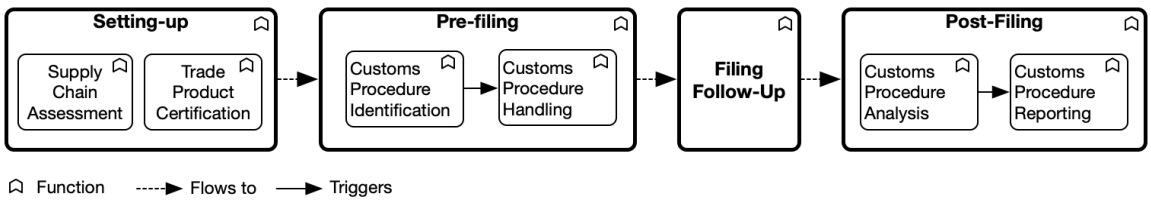
[15] The Customs territory of the European Union is defined in Art. 4 UCC. More information at: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1567087493358&uri=CELEX:02013R0952-20190515

Based on these considerations, it is suggested that the execution of the Customs compliance function should be based on the following core Elementary Business Functions (EBF):

- Setting-up..... Occurs before a transaction takes place and involves:
  - Supply chain assessment;
  - Trade product certification.
- Pre-filing..... Occurs within the context of a specific transaction and involves:
  - Customs regulatory procedure identification;
  - Customs regulatory procedure handling;
- Filing follow-up... Occurs within the context of a specific transaction between the moment the filing instructions are communicated and the filing has been done.
- Post-filing..... Occurs after a specific transaction has taken place and involves:
  - Customs regulatory procedure analysis;
  - Customs regulatory procedure reporting.

The logical flow between these EBFs (i.e. the 'engine' of the practices) is represented in Figure 5.

Figure 5: Customs compliance core elementary business functions (Archimate representation)



Additionally, in the scope of their digitalisation, those core EBFs should be complemented by supporting functions, such as exception handling, monitoring, and reporting & analysis, all of them contributing to the continuous improvement of compliance operations (Kubat, 2019).

Customs compliance business actors

For large companies such as MNEs, the achievement of Customs compliance requires multiple interactions with both internal and external stakeholders[16] – also called *business actors* as per the Archimate terminology.

This large quantity of involved stakeholders increases the complexity of the supply chain management (Sardar & Lee, 2015, Veenstra, 2019). When the MNE plays the role of the importer and exporter (or buyer and seller respectively), then it has the responsibility to fulfil all required customs formalities in order to ensure compliance regarding the cross border movements (Coyle et al., 2012).

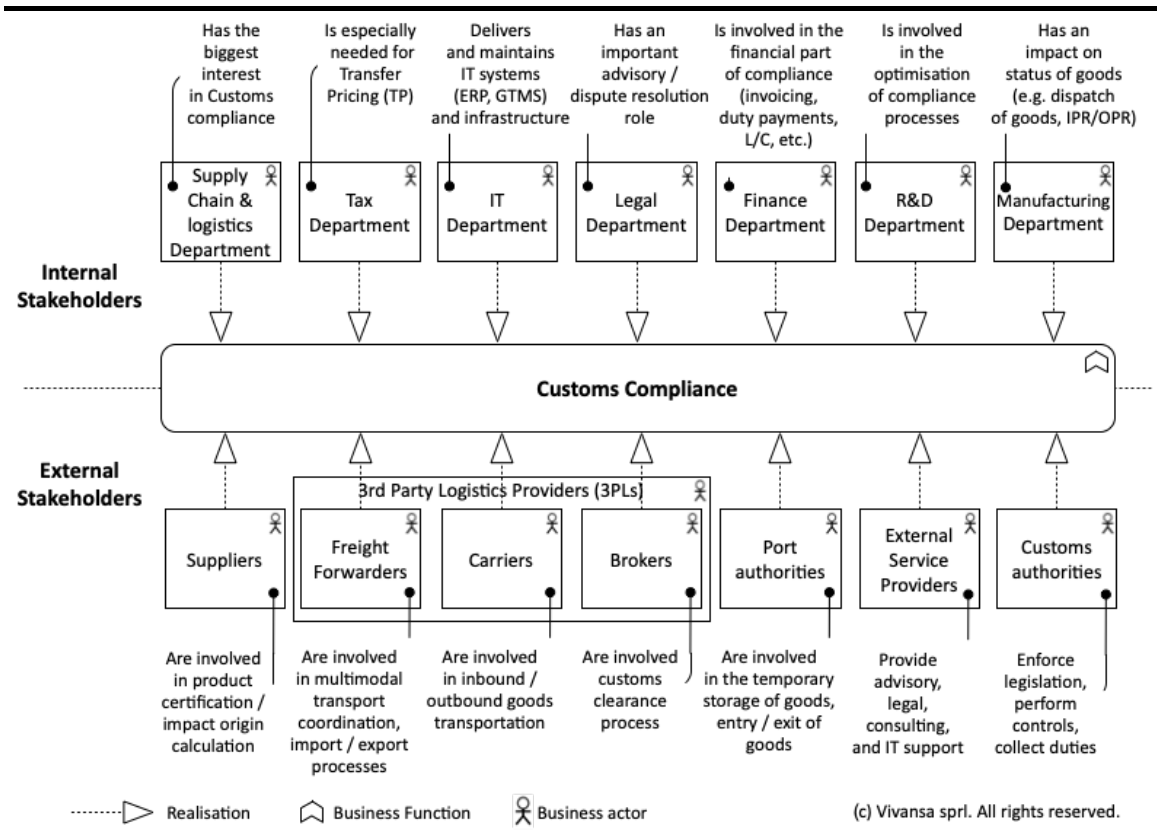
Due to the difficulty of having these formalities in control, the importer-exporter relationship is often extended with 3rd Party Logistics providers (3PLs) such as brokers and freight forwarders (Świerczek, 2014), which in turn divide the responsibilities of the transportation to various carriers (Veenstra, 2019), altogether discharging MNEs from managing complex logistics chains.

The drawback of this situation is that compliance practitioners, in particular those of large companies operating globally, lose some visibility on compliance operations and, therefore, cannot adopt proactive management of Customs compliance. So, it is not a surprise that some MNEs, citing low value for money, are taking the compliance function back in-house.

Based on the above, it is possible to provide an Archimate representation of the Customs compliance function seen from the *business actors* perspective (Figure 6).

[16] This aspect was also highlighted during the Unilever presentation at the workshop organised in February 2020 by the Rotterdam School of Management (RSM) - Erasmus University.

Figure 6: Customs compliance function and related business actors (Archimate representation)



Customs Compliance business collaboration

The representation made in Figure 6 highlights the cross-cutting nature of the Customs compliance function and the importance of this function (in the scope of its digitalisation) to be supported by effective *business collaboration*s. Indeed, establishing effective business collaborations between the involved parties is absolutely essential to the successful execution of compliance operations.

For those business collaborations to be effective there is a need for federating the involved parties around three characteristics, which are those of ecosystems (Adner, 2016): an *alignment structure*, a *partnership*, and a *focal value proposition*.

- Alignment is the extent to which there is a mutual agreement among the stakeholders participating in the achievement of Customs compliance regarding their positions and the flows among them. Alignment, thus, refers not only to compatible incentives and motives but also raises the question of stakeholders' consistent construal of the configuration of activities.
- Partnership means that participating actors in Customs Compliance have a joint value creation effort as a general goal. The goal may or may not be ultimately achieved. The defining attribute of *partners* is that they are actors on whose participation the value proposition depends, regardless of whether or not they have a direct link to the focal firm.
- The focal value proposition is the promised benefit that the stakeholders expect to receive as opposed to a *focal firm*. The concept of trusted tradelanes (Veenstra, 2019) is a relevant example of such a focal value proposition involving a compliance regime that covers an entire supply chain. Such a regime requires 1) the structured identification of risk in the supply chain, and 2) the transmission of data along the supply chain through the *data pipeline* (Klievink et al. 2012).

A similar approach based on the formalisation of *tradelanes* could advantageously serve the specific scope of Customs compliance, as it would allow formalising root collaborations between parties at various levels: commercial, logistics, financial, and regulatory[17].

[17] Refer to the UN/CEFACT Multi Modal Transport Reference Data Model for the codification of those levels.

The tradelane formalisation can therefore be seen as a form of specialisation of a business collaboration affecting Customs compliance, which can be related to the context of a trade transaction and represented as a set of stages (planned or executed) between a point of origin (Ship from) and a point of destination (Ship to).

At (data pipeline) technology level, the combined usage of social network frameworks, of Digital Platform & Ecosystems (DPE), and W3C[18] Semantic Web standards for data management should be considered as solid assets to achieve effective business collaborations (Ashton, 2008).

Customs compliance business activities

The regulatory procedures that companies involved in cross-border trade or manufacturing under bonded conditions should follow involve the execution of a number of *business activities*. Indeed, as emphasised by Sadiq et al. (2007), the Customs compliance function refers not only to comply with regulations and rules but includes all activities supply chains perform to ensure correctness, continuity and effectiveness. Those activities cover multiple compliance areas such as tariff classification, Customs valuation, certificate of origin, declaration filing, special licenses, and export controls.

Table 7 provides an overview of those business activities (or 'tasks') for each compliance area (as adapted from Keer, 2009) and provides the indication of their occurrence by linking them to the EBFs defined above.

Table 7: Key Customs compliance areas and their related business activities - Adapted from Keer, 2009

Customs compliance area	Related business activities (or 'tasks')	Occurrence
Pre-shipment inspection and license requirements	**Get assurance that pre-shipment inspections are done.** These inspections and requirements particularly affect used and refurbished products, medical devices, pharmaceuticals, and agricultural and food products. **Obtain pre-shipment approval.** Products that have been repaired and are being imported as "replenishment stock" for use in after-sales servicing are considered used and require pre-shipment approval for their import. Such products cannot be stored within bonded facilities.	Setting-up
Harmonized System of tariff classification	**Perform correct classification.** Incorrect classification affects duty rates, value-added tax rates, origin, labelling, permit requirements, license requirements, export controls, and import-export prohibitions and restrictions.	Setting-up Pre-filing
Customs value	**Perform Customs valuation checks.** Related parties are subject to valuation checks. Transfer pricing shall apply guidelines and rules that are recognised by the concerned Customs authorities. If royalties, distribution fees, and franchise fees are applicable, they may be added into the value.	Pre-filing
Certificate of origin	**Gather trade product documentation.** Companies should ensure they have correct documentation that is fully certified by the approved issuing authority in the country of manufacture.	Setting-up
Customs licenses and approvals; business licenses	**Verify that licenses and approvals are in place and still valid.** It is necessary to verify compliance with processing trade approvals and associated manuals; Compliance with acquired approvals; and Compliance with the approved scope and any other requirements.	Setting-up
Entities in bonded locations	**Monitor the bonded zone's customs requirements and comply with them**. **Confirm that controls on the movement of goods within and outside of a**	Setting-up Monitoring

[18] See Semantic Web standards published by the World Wide Web Consortium (W3C) at: https://www.w3.org/2001/sw/wiki/Main_Page.

	bonded facility are in place and effective. **Comply fully with processing-trade export requirements** (if a processing-trade entity), and obtain the appropriate approvals (if importing finished products). **Review security and inventory controls**.	Exception Handling Reporting & Analysis
Customs brokers and logistics service providers	**Set controls to monitor the work that third parties do on the company's behalf**. The acts performed by third parties regarding a company's goods are legally the acts of the principal.	Setting-up
Employees	**Ensure that job descriptions are clearly defined**. **Organise staff training plan and staff awareness program**. Companies should also be aware that disgruntled employees could divulge company information to authorities.	Setting-up Monitoring
Foreign Corrupt Practices Act (FCPA) and similar legislation	**Provide good FCPA-related (or similar) training and awareness programs** to all employees and third-party service providers. **Ensure that effective controls on discussions with government authorities are in place** as well as any proposed entertainment of these authorities.	Setting-up
Export control legislation	**Perform compliance checks within export control legislation** to ensure the company has the correct instructions for its products.	Setting-up Pre-filing
Document retention	**Perform document retention**. Customs, State Administration of Taxation, and business registration laws all require some form of document retention. Companies need to understand what each document is and in what format it can be retained.	Post-filing Reporting & Analysis
Finance	**Record inward and outward revenue**. It is needed to ensure that the recording of payments made or received and their associated orders or purchase agreements are accurate, complete, and properly authorized.	Post-filing Reporting & Analysis
Internal logistics	**Verify that the actions that personnel in the logistics area take comply fully with Customs and other cross-border requirements**.	Post-filing Reporting & Analysis

Customs compliance business services

A Customs Compliance (business) Service (CCS) is meant to expose one or several measures (e.g. perform duty calculation) as a Value-Added Service (VAS) and makes it (them) accessible through a standard communication channel. A CCS is realised by one or several customs compliance processes and can be offered by multiple Service Providers. As far as automation is concerned, such services are subject to the implementation of web services with standardized contracts, establishing canonical models that must be accepted by any service provider (possibly with mitigation measures such as data mapping).

> *A business service represents explicitly defined behaviour that a business role, business actor, or business collaboration exposes to its environment. Its functionality is accessed through one or more business interfaces. A business service should provide a unit of behaviour that is meaningful from the point of view of the environment. It has a purpose, which states this utility. The environment includes the (behaviour of) users from outside as well as inside the organization. Business services can be external, customer-facing services or internal support services A business service may serve a business process, business function, or business interaction. A business process, business function, or business interaction may realize a business service* (Archimate, 2019).

Relevant Customs Compliance Services are listed in Table 8.

Table 8: Customs compliance business services

Tariff Classification Service	A service that classifies a trade product according to its nature, packaging and destination (i.e. customs territory). The relevant Customs Tariff is applied in order to determine the HS code to be used that identifies the trader product classification in a customs procedure and/or declaration.
Customs Valuation Service	A service that determines the Customs Value of a trade product in the context of a customs procedure, its price as stated in a commercial or financial document (e.g. invoice), its transport costs associated with shipment & consignment (e.g. freight costs), and other associated costs (e.g. insurance) or revenues (e.g. royalties).
Origin Calculation Service	A service is that determines the (non-) preferential origin of a trade product according to its Customs Value, its nature and composition (i.e. Bill Of Material), its processing, its destination (i.e. customs territory at export).
Customs Duty Calculation Service	A service that calculates the customs duty (expected) to be paid when declaring a trade product according to its classification, the applied procedure, its customs value, its origin, and the applicable customs tariff and possible FTA.
Export Control Service	A service that determines the requirements (if any) in terms of export licenses and certificates.
Customs Regulatory Procedure Handling Service	A service offered to handle customs regulatory procedures and to fill customs declarations with a specific set of national customs authorities.

Findings of the assessment of the Customs Compliance function

The assessment of the Customs compliance function contributes to addressing the knowledge gap identified during the literature review. This contribution has consisted in proposing a definition for Customs compliance, to formalise the Customs compliance Elementary Business Functions, to inventory the list of Customs compliance business activities, and to reveal the cross-cutting nature of the function by identifying Customs compliance business actors and the related ecosystem-based Customs Compliance business collaborations.

A major outcome of this contribution is the clarification that it brings in terms of the *necessary control* that any digitalisation initiative is meant to bring to the compliance practitioners. Actually, to bring the *necessary control* over compliance operations, any digital implementation should be able to support:

1. All identified Customs compliance Elementary Business Functions (the 'workflow' of the practices);
2. All horizontal Customs compliance business collaborations between multiple actors, both internal and external (the 'ecosystem' of the practices);
3. All identified Customs compliance business activities (the practitioners 'to-do list');
4. All required Customs compliance services (either provided in-house or by external Customs-related Service Providers (CRSP)) allowing to execute the identified tasks (the 'execution' of the practices).

Implementations (whether it concerns GTMS or ERPs) which only partially support those requirements are likely to fail in providing compliance practitioners with the necessary control over their compliance operations.

GTMS Market Review

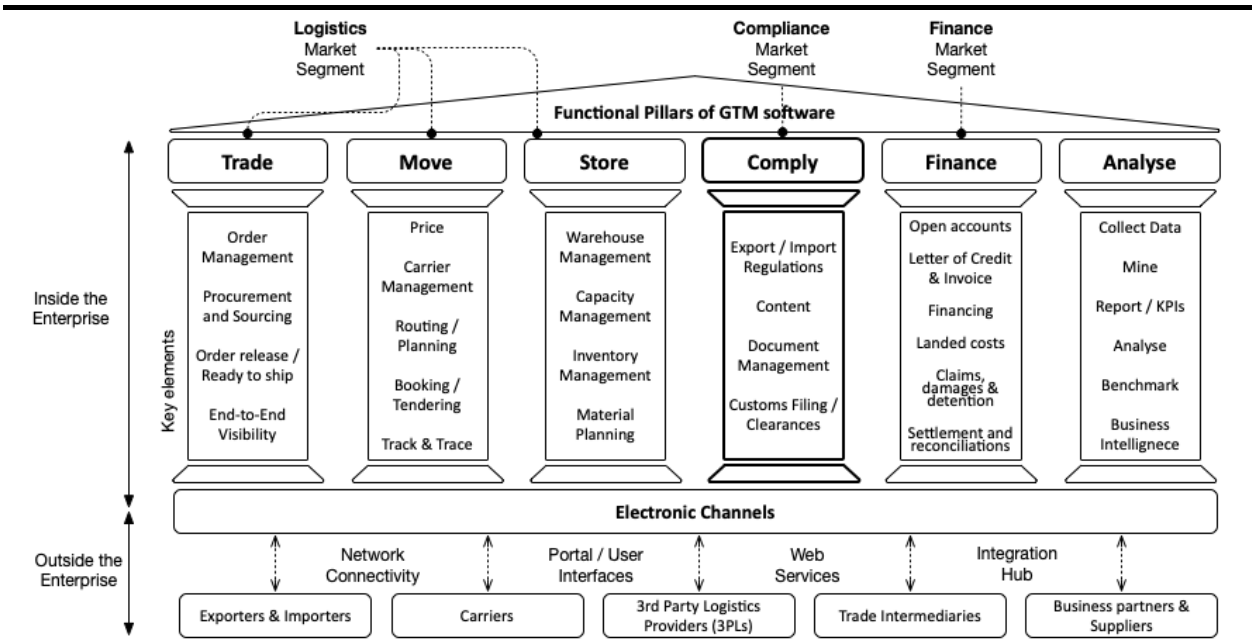
Introduction

This part aims at answering the research sub-question c). The assessment of compliance practices at several representative MNEs indicates that GTMS are only partially used in these environments, which could explain the relative inefficiency of GTMS implementations to provide practitioners with the necessary control over their compliance operation. In order to clarify this point, it is required to conduct a research activity allowing to obtain a better view of the GTMS offering and the way the GTMS market is structured. Given the high competition on this market and the reluctance of GTMS vendors to communicate information about their products that goes beyond usual marketing materials, the contents of this chapter are essentially based on desk research.

Functional pillars of GTMS

A GTMS is meant to facilitate businesses by simplifying the trade processes, such as collaborating with supply chain partners, providing data on efficient transportation options, and updated country-specific regulatory compliances. Figure 7 describes the functional pillar traditionally covered by GTMS solutions and their related market segments.

Figure 7: Functional pillars of a Global Trade Management Software (adapted from the representation made by Joshi (2011) as well as from market segments identified by Gartner (2019)).



GTMS Market

For many years, GTMS has been managed and executed tactically, with little regard for an overarching technology strategy or aligned business policies and standards. Companies approached GTMS in a piecemeal fashion, without determining how functional activity can or should align with other supply chain processes. In many cases, this was fostered by the historical practice of companies outsourcing the handling of international shipments, thereby reducing the need for companies to invest directly in GTMS-specific systems. Gartner (2019)

In recent times, the GTMS market[19] has witnessed a steady growth in the overall trade between different countries worldwide due to increased globalization and advanced technologies aiding cross-border sales. Globalization and growth of online retailing (e-Commerce) have subsequently increased cross-border sales. This has further increased the complexities of managing the overall process of global trade, such as tracking shipments, communicating between large networks of customers and suppliers, and operating on tight margins due to the fluctuating global economic conditions.

[19] Refer to https://www.databridgemarketresearch.com/reports/global-trade-management-market?AM

GTMS market value

The GTMS market is expected to rise from its initial estimated value of USD 775.28 million in 2018 to an estimated value of USD 1602.422 million by 2026, registering a CAGR of 9.50% in the forecast period of 2019-2026.

GTMS vendors

Representative vendors in GTMS are SAP, E2open, Descartes Systems Group, Blujay, Infor, Oracle, and WiseTech Global. The detailed list of vendors flagged by market segment (i.e. L = Logistics, C = Compliance, and F = Finance) is provided in Appendix B.

The last decade, which has seen a generalisation of Digital Platform & Ecosystems (DPE) and Cloud Computing, has conducted most of the GTMS vendors to promote the *platformization* of their portfolio. However, what GTMS vendors call a *platform* is a complete misnomer, because each vendor has total control on the platform it operates and is reluctant to offer integration capabilities with solutions from other vendors they compete with. Consequently, those so-called platforms are not more nor less than additional concentration points (or 'silos') creating vendor lock-in situations that are antagonistic to the support of ecosystems (Adner, 2016), which are proteiform by nature.

GTM market direction

Gartner (2019), in its market guide for Global Trade Management software, indicates that the GTM software market still continues to have a rapid consolidation. Traditionally, global trade management software vendors focused mostly on one of the major areas: international logistics, trade compliance or finance. However, the world is a big place and according to Gartner (2019), it is unrealistic to expect one software vendor to cover all of the global trade.

To grow the business, many software providers acquire other companies to add new functional capabilities, trade content services or new geographic coverage. Consolidation and acquisition continue unabated. E2open's latest acquisition of Amber Road[20] adds GTM expertise to a broad range of supply chain solutions that already included the acquisitions of Cloud Logistics, INTTRA, Terra Technology, Orchestro, Steelwedge, Zyme, Birch Worldwide and Entomo, among others. Other representative vendors that have been very active in terms of acquisitions are Descartes Systems Group (PinPoint, Visual Compliance and CORE Transport Technologies) and WiseTech Global (Systema, Containerchain and Xware in 2019 alone). Thomson Reuters, which acquired Softway in 2013, added Integration Point in 2018.

GTMS solutions may also compete with many Transport Management Systems (TMS), but their capabilities in addressing the specific requirements of global transportation might be very different. Several ERP-based vendors have been late entrants in this space. Despite the limited functional depth, ERP-based GTM packages such as SAP GTS and Oracle GTM provide the advantages of tight integration and seamless flow of information with the back-end ERP applications and thus other business functions. However, we often find that this integration between ERP and their GTM package is not up to the required levels or is not readily available. This might reduce the advantages of such solutions. However, given the global security concerns on data integrity, the traditional 'behind-the-firewall' on-premises model is here to stay for some time, even if one sees a strong emergence of cloud-based SaaS solutions.

Compliance segment relatively unserved

Joshi, 2011 reports that, despite the evolution of GTMS solutions and their extensive use, a large part of GTM functions – specifically those of compliance – are still managed manually by businesses, thus increasing the risk of reporting errors to statutory authorities. To mitigate non-compliance risks (Ernst & Young LLP, 2006, Mintzer et al., 2011), many businesses operating globally rely on 3rd Parties Logistics providers (3PLs) such as freight forwarders or brokers to manage the compliance-related roles, thus reducing the need to invest directly in GTM-specific systems. More recently, Gartner (2019) reports that citing low Value *for* Money (VfM) and lack of global visibility offered by 3PLs, the trend is businesses – mostly MNEs – taking the compliance function back in-house because of GTMS support having improved.

[20] Read article "Amber Road Acquisition Complete", E2open (https://www.e2open.com/e2open-completes-acquisition-of-amber-road/)

The difficulty, however, to operate that strategic change is, despite the acquisitions, much of the market is still served by regional players. Major countries like Brazil, Russia and China, among others, are undersupported by the GTMS community at large, usually because of the unique challenges of conducting business in these countries. Moreover, complex financial and Customs regulations often require organisations to rely on local solutions that were either built at the same time and along with the regulations or certified by the government to support their processes. Finally, volatile political landscapes and economic policy changes cause confusion on how companies should address global trade compliance and how the software vendors can help.

Blockchain starting to find its niche

While many supply-chain-related blockchain[21] initiatives are nascent with solutions in the early stages of development, interest in GTMS have accelerated significantly. These initiatives are a mix of vendor-led, industry and consortium-driven discussions. Blockchain is aligned to potentially fulfil the critical and long-standing challenges presented above across dynamic and complex global supply chains. Examples include:

- The Blockchain in Transport Alliance (BiTA): This commercial alliance includes more than 500 members from the freight, transportation, logistics, and software industries to drive standardization and adoption of blockchain in transportation[22].
- TradeLens: IBM and A.P. Moller - Maersk continue to grow the number of participants on their block-chain-enabled logistics visibility platform with more than 100 companies now using the platform[23].
- Global Shipping Business Network (GSBN): This is a rival blockchain-enabled shipping logistics visibility platform founded by CargoSmart and nine ocean carriers and terminal operators[24].
- Korean Customs Service: Korean Customs Service is adopting blockchain to enable visibility into e-commerce and transportation[25].
- Universal Trade Network: This project intends to create a network of networks in trade by introducing standards and support for the interoperability among the different financial blockchain networks[26].
- Marco Polo Network: This network provides increased visibility, traceability and security for banks, their corporate clients and logistics providers on a common platform[27].
- Voltron: Voltron offers a platform based on Corda blockchain technology, aiming to digitize the letter of credit paperwork process and increasing operational efficiencies among financial firms and their trade clients[28].

Despite the recent advancements, Gartner (2019) recommends using caution when considering blockchain. Right now, it should be viewed as a potential complementary technology, not as a wholesale replacement.

Findings of the GTMS market review

Customs compliance due to its extreme local specialisation remains a major obstacle for GTMS to become truly global. In its market guide for Global Trade Management software, Gartner (2019) concludes that one way to become a global platform is to acquire other companies to enter new geographical areas, new modes of transportation, or totally new processes and areas of the supply chain. Despite the consolidation in technology, product portfolios remain siloed, selling to different buyers in the organisation and making cross-selling opportunities relatively limited. One major reason is that, although the technology has converged (e.g. by the wider adoption of SaaS offerings), the supporting people and processes in MNEs have not.

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[21] A blockchain is an expanding list of cryptographically signed, irrevocable transactional records shared by all participants in a network. Each record contains a timestamp and reference links to previous transactions. With this information, anyone with access rights can trace back a transactional event, at any point in its history, belonging to any participant.

[22] "Blockchain in Transport Alliance", Blockchain In Transport Alliance (BiTA).

[23] "Maersk Adds Two Big Shipping Firms to Its Blockchain Ledger", Computerworld.

[24] "Top Ocean Carriers and Terminal Operators Initiate Blockchain Consortium", CargoSmart.

[25] "Korea Customs Service Seeks to Implement Blockchain and AI", TokenPost.

[26] "Universal Trade Network becomes Digital Standards Initiative as ICC adopts it", Trade Finance Global.

[27] "Marco Polo lowers barriers to entry for blockchain trade finance", Ledger Insights.

[28] "Voltron trade finance blockchain runs trial with 50 participants", Ledger Insights.

In relation to the Customs compliance segment, three key elements emerge from the review:

1. The high segmentation of the GTMS market results in different buyers in the same MNE organisation acquiring various GTMS modules from different vendors. This situation potentially creates hard-to-solve integration issues, leaving trade departments relatively ill-equipped to run their compliance operations.
2. Most of GTMS portfolios adopt a vertical segmentation addressing three main markets: logistics, compliance, finance. However, the assessment of the Customs Compliance Function indicates that it does not fit well with such vertical segmentation.
3. The strong competition between GTMS vendors, each one promoting its own platform and leading to additional silos for MNEs, is an obstacle to reaching the level of federation that Customs Compliance business collaborations require. GTMS should be used for what they are aimed at, i.e. global trade management, and it would be a mistake for MNEs to concentrate on the GTMS both the trade management function and the data pipeline function, which is meant to be a *federated solution* by nature (Klievink et al., 2012).

These elements are likely to explain why the preventative focus of Customs compliance – aiming at facilitating the propagation of Customs compliance requirements into business process models and enterprise applications – seems not to be optimally supported by current GTMS implementations, as reported by MNES compliance practitioners (cf. qualitative survey). They also explain why GTMS products are relatively underused and seem to be doomed to never be able to offer their full potential as long as they continue to be approached in a piecemeal fashion and that their integration capabilities remain limited.

Bottom Line

The outcomes of the research activities conducted concurrently on the assessment of Customs compliance practices at several MNEs, the Customs Compliance Function, and the GTMS market, allow concluding that the problem initially formulated (cf. Problem Statement) is relevant. Indeed, the Customs compliance function appears not to be optimally supported by current GTMS implementations and compliance practitioners are struggling to get the necessary control over their compliance operations. Moreover, the analysis shows that neither the GTMS customisation nor the adaptation of the company internal processes to the GTMS is likely to produce any tangible benefits to address this problem. The main reasons are:

- Customs compliance due to its extreme local specialisation remains a major obstacle for GTMS to become truly global and to cover all the needs of MNEs. MNEs are anyway required to rely on local solutions that coexist with the GTMS, which is not without creating complex data integration issues;
- The highly segmented GTMS market results in MNEs to approach GTMS products in a piecemeal fashion, which is an obstacle for GTMS to deliver their full potential;
- GMTS portfolios remain siloed and do not fit well with the cross-cutting nature of the Customs compliance function, which requires effective collaboration between multiple stakeholders. Therefore, supposedly best practices promoted by GTMS vendors are likely to be inoperative to address the requirements of the Customs compliance function.

To address this problem, this thesis argues that a change of paradigm is required: **instead of trying to break silos, the objective should be to connect them effectively and think in terms of business ecosystems as a new way to organise the collaboration with all the stakeholders (both internally and externally) according to their respective role and responsibility with regards to the Customs compliance function.**

This highlights the need for **an intermediary component able to support business collaborations and federate existing assets** inside and outside the organisation so as to provide MNEs practitioners with the necessary control over their compliance operations.

Armed with the business requirements gathered during this chapter, the objective of the next chapter (Chapter 5 - Artefact Design) is to produce the design of an artefact establishing the foundation of such an intermediary component – namely the Compliance Control Tower Design Pattern.

Chapter 5 – Artefact Design

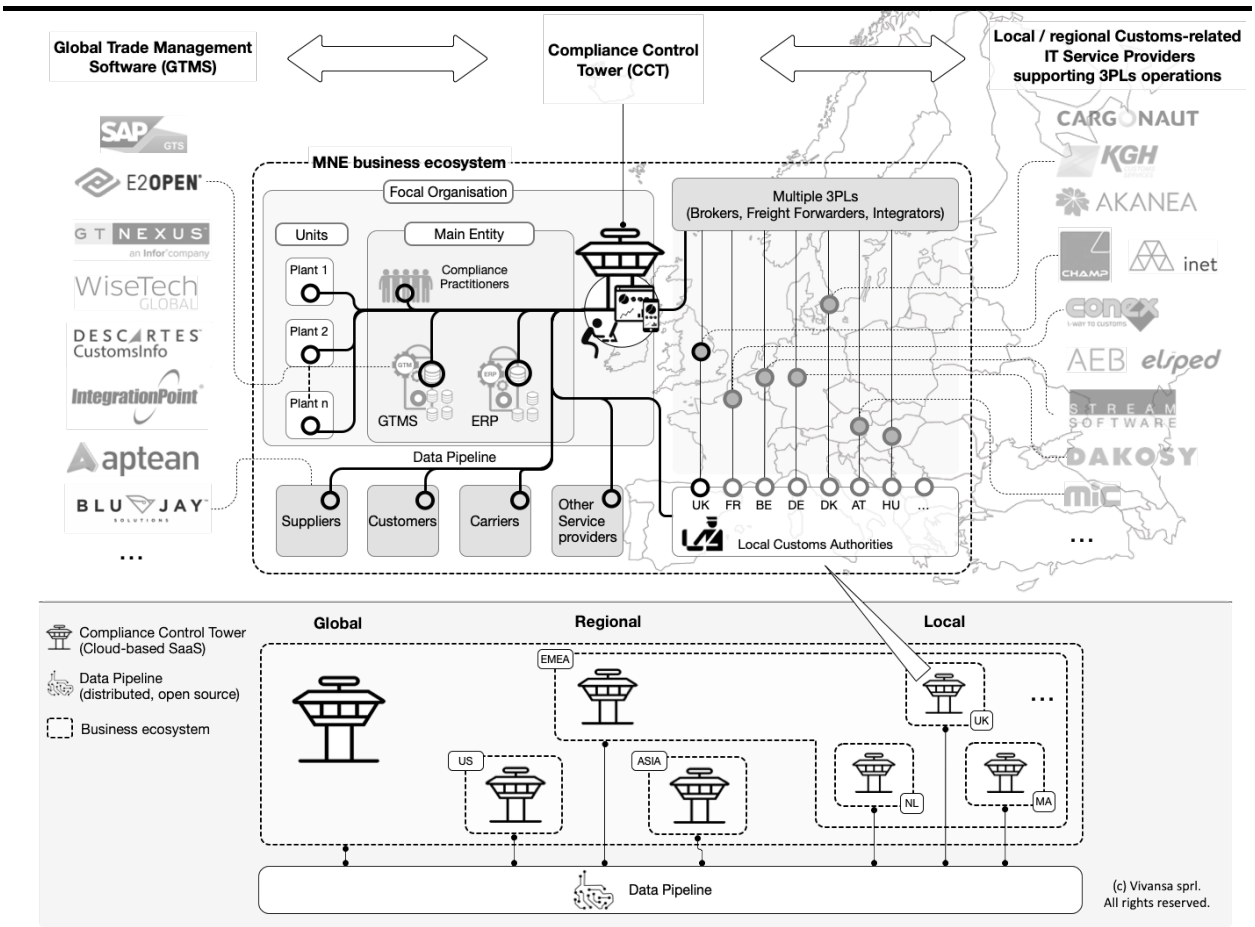
Introduction

This chapter describes the artefact of this research, namely the *Compliance Control Tower (CCT) design pattern*, which is instantiated for the specific field of Customs (CCT-C). After presenting the Compliance Control Tower (CCT) concept, this chapter provides the key requirements, which are derived from the analysis conducted at Chapter 4. Those requirements are then used to establish the foundation of the Compliance Control Tower (CCT) design pattern. Because the CCT design pattern is meant as a compound design pattern, this chapter also describes all (new) patterns entering into the composition of the CCT design pattern. The representation of all design patterns complies with the ArchiMate® 3.1 Specification (2019). Finally, this chapter provides the list of technology and standards which are relevant when considering the usage of the CCT design pattern at build time (e.g. prototyping).

Compliance Control Tower (CCT) concept

The Compliance Control Tower (CCT) is an enabler of compliance practices supporting various areas of specialisation, such as Customs, excise, and VAT. The CCT allows companies operating globally to have their compliance operations fully in control by means of efficient B2B and B2G collaborations between the parties (both internal and external) having a role in achieving compliance. To do so, the CCT takes advantage of the data management services provided by the underlying data pipeline, which plays the role of *federator* of existing assets whether it concerns internal systems (e.g. GTMS, associated ERPs, and local solutions) or external systems provided by 3PLs (e.g. Customs filing services). As a result, the CCT represents a significant departure from what MNEs are often accustomed to (which typically involves organisational silos, disjointed systems, and tightly coupled EDI channels) and let them enter into the era of interrelated business ecosystems (Figure 8).

Figure 8: Compliance Control Tower (CCT) concept



The CCT orchestrates the entire Customs compliance value network and offers considerable benefits and capabilities, from end-to-end Customs compliance visibility to advanced automation tasks. With the CCT, MNEs benefit from an intermediate decision-support component, which allows Customs compliance practitioners to organise their daily work in an optimal way and turn Customs compliance into *value*. To cope with the locational implications that MNEs offshoring and outsourcing strategy have on the supply chain, the CCT offers ecosystem-based virtualisation capabilities (e.g. from local, to regional, to global) able to adapt to potentially any type of organisation of MNEs' trade departments, thus offering compliance practitioners with the visibility they require, anytime, anywhere. To do so, a CCT instance is attached to one (or several) focal organisation(s), each focal organisation being characterised by one main entity and its related units.

Key requirements establishing the design foundation

The findings of these research activities allow deriving the key requirements establishing the foundation of the *Compliance Control Tower design artefact*, which is meant to help MNEs to reach their business objective in terms of enhanced digitalisation of Customs compliance.

For the CCT to be able to reach the expected objectives in terms of necessary control over compliance operations, it is of key importance that it can rely on a Data Pipeline able to provide the expected functionality in terms of data management, which according to the analysis conducted in Chapter 4, should require the combined usage of Digital Platform & Ecosystem (DPE), social networking, and Semantic Web data network management.

For the sake of clarity and also to ease the cross-referencing, each key requirement formulated below (Table 9) is tagged with a unique identifier following the REQ.<level>.<99> nomenclature, where <level> provides the indication on whether the requirement applies to the Compliance Control Tower design (= CCT) or to the supporting Data Pipeline (= DP).

Table 9: Key Requirements establishing the design foundation

id.	Label	Applies to:
REQ.CCT.00	**The artefact shall primarily be meant as an enabler of Customs compliance practices.**	CCT
	The digitalisation of Customs compliance in the context of companies operating globally has to be driven by Compliance practices. To provide the necessary control over Compliance operations, the compliance practices enabler shall allow implementing the Customs compliance elementary business functions by the concurrent enablement of business collaborations, compliance tasks (assigned to users or systems), and compliance services (either manual or automatic).	
	REQ.CCT.01 Enable business collaborations	CCT
	REQ.CCT.02 Enable compliance tasks management	CCT
	REQ.CCT.03 Enable compliance services	CCT
	Moreover, to ease the linkage of disparate, geographically dispersed data sources, the platform supporting the instantiation of compliance practices, should preferably:	
	REQ.DP.01 Make use of Cloud Computing[29] (CC) based technology Cloud computing (CC) offers significant advantages particularly for the decentralized and loosely coupled nature of Global Supply Chains (GSC), due to the fact that IT processes are becoming more and more stable and flexible, e.g., through scalability and virtualization.	DP

[29] The National Institute of Standards and Technology (NIST) defines Cloud Computing (CC) as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction" (Mell and Grance, 2011). But CC does not represent a new technology. Rather, it stands for a new paradigm for IT processes (Youseff et al., 2008) by consistently linking individual, existing technologies (Leimeister et al., 2010). The majority of the research literature distinguishes between three service models (Hoberg et al., 2012; Mell and Grance, 2011): "Infrastructure as a Service (IaaS)," "Platform as a Service (PaaS)," and "Software as a Service (SaaS)."

REQ.CCT.01 **Enable business collaborations** CCT

The collaborations between the parties taking part in the ecosystem can be of various types such as Business-to-Business (B2B), Business-to-Government (B2G), or Government-to-Business (G2B). Collaborations are made of structured contexts for specific interactions. These interactions allow the exchange of master data elements that the involved professionals must understand, recognise, and eventually augment to support their own specific business processes. At business level, business collaboration should be formalized using the concept of tradelane (or equivalent). At platform level, business collaborations should rely on the services concurrently provided by the Digital Platform & Ecosystem (DPE), the social network, and the Semantic Web data network.

REQ.CCT.04 **Make use of Tradelanes** CCT

Within an environment where various types of trade transactions are executed in autonomy and interlinked opportunistically, it is difficult to plan and control compliance measures. Therefore, there is a need for a set of trade transactions to be categorised, codified and formally interlinked in order to control their executions and take the required compliance measures in time. The formalisation as tradelane should help achieve this objective.

REQ-DP-02 **Make use of Digital Platform & Ecosystem (DPE)** Data Pipeline

The DPE is an enabler of the business ecosystem construct through which the Customs compliance function can be implemented through the perspective of an economic community including multiple (internal and external) parties, thus stepping outside the (sometimes narrow) framework of the enterprise.

REQ-DP-03 **Make use of Social network-like technology** Data Pipeline

Given the cross-cutting nature of Customs compliance, social interactions have even higher importance. Establishing closer ties between trading parties (i.e. suppliers, transporters, manufacturers, freight forwarders, brokers, etc.) is increasingly cited as a critical differentiator of high and low performers in global supply chains.

REQ-DP-04 **Make use of Semantic Web data network** Data Pipeline

Compliance practitioners, whatever the role they have in the Supply Chain, must agree on the nature and the semantics of their business collaborations by the means of a bilateral recognition process. To do so, they use the Master Data Management (MDM) and SOA Canonical Schema Bus Facilities that the Data Pipeline makes accessible to them. Hence, the following key requirements:

REQ-DP-05 **Master Data Management**
REQ-DP-06 **SOA Canonical Schema Bus**

REQ.CCT.02 **Enable compliance tasks management** CCT

There is a need for (to be executed) compliance business activities (=tasks) to be identified, registered, assigned and executed in a controlled way. This should be the role of a Compliance Task Manager to answer this requirement. To that aim, the Task Manager shall be able to react on business events tracked by Compliance Control Points (CCP) and to trigger the execution of Compliance Measures (CM).

REQ.CCT.05 **Compliance Control Point (CCP)** CCT

Complex business processes involving multiple business functions of the organisation can lead to a lack of control when they should be associated with compliance activities. Therefore there is a need for business events to be automatically detected across the various organisation's business functions, in such a way they can be associated with pre-defined compliance activities (or measures) following dynamic Complex Event Processing (CEP) rules (Luckham, 2002).

REQ.CCT.06 **Compliance Measure (CM)** CCT

Compliance measures that are not well-defined and assigned to relevant

parties at the right time cannot be efficiently executed and controlled. Therefore, there is a need for a set of compliance measures pertaining to a specific ecosystem to be pre-defined and codified as (automated) business processes (or workflows) that trigger the execution of compliance activities assigned to parties according to their capabilities and positioning inside the ecosystem.

REQ-DP-07 SOA Orchestration DP

An orchestration platform is dedicated to the effective maintenance and execution of parent business process logic. Modern-day orchestration environments are especially expected to support sophisticated and complex service composition logic that can result in long-running runtime activities.

REQ.CCT.03 Enable compliance services CCT

Much of the market is still served by regional players. Complex financial and Customs regulations often require organisations to rely on local solutions that were either built at the same time and along with the regulations or certified by the government to support their processes. Therefore there is a need for the CCT to be able to consume compliances services which could be of various nature (in-house, external) and accessible through various channels (Web service, file drop, EDI, etc.).

REQ.CCT.07 Compliance service CCT

Compliance capabilities offered by various parties without standardised interfaces are difficult to integrate. Therefore, there is a need for compliance capabilities to be exposed by service providers as services according to standardised service contracts in order to be dynamically consumed through the execution of configurable compliance measures.

REQ-DP-07 SOA Enterprise Service Bus (ESB) DP

An enterprise service bus represents an environment designed to foster sophisticated interconnectivity between services. It establishes an intermediate layer of processing that can help overcome common problems associated with reliability, scalability, and communications disparity.

REQ-DP-08 SOA Federated Endpoint Layer DP

Federation is an important concept in service-oriented computing. It represents the desired state of the external, consumer-facing perspective of a service inventory, as expressed by the collective contracts of all the inventory services. The more federated and unified this collection of contracts (endpoints) is, the more easily and effectively the services can be repeatedly consumed and leveraged.

Compliance Control Tower (CCT) Design Pattern [artefact]

The Compliance Control Tower design pattern is the architectural element that allows trade compliance to be accurately controlled inside complex business ecosystems. This pattern allows for various functional specialisations such as Customs, excise, VAT, and others. It offers a generic template format so that it can be repeatedly applied in various IS implementations, thus facilitating the digitalisation of the Customs compliance function. It can also be combined into compound patterns to solve larger problems.

Being primarily focused on Compliance practices [REQ.CCT.00], the CCT design pattern is composed by the Compliance Practice Enabler design pattern and, at run time, is meant to provide visualisation and decision-support facilities (through dashboards) according to the roles and responsibilities of the involved parties.

The application of the Compliance Practice Enabler allows practitioners (the 'human systems users') to be guided with context-relevant instructions (in real-time, with real data and information) that is adapted to their cognitive abilities and background knowledge (i.e., instructions they can understand and use to achieve compliance).

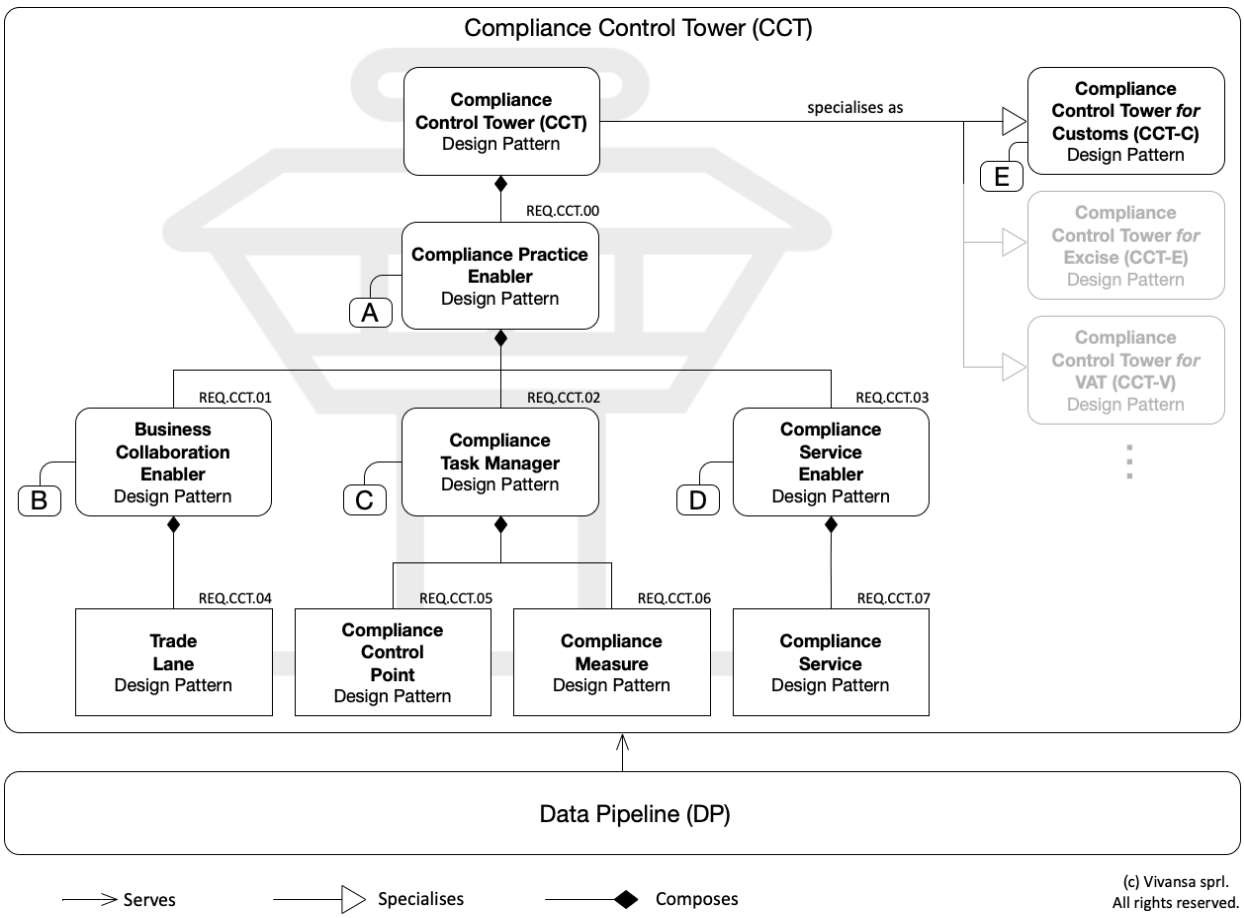
To that aim, the enablement of compliance practices makes use of:

- Business Collaborations [REQ.CCT.01], referring to identified of B2B relationships that are planned (e.g. as per supply chain assessment or product certification functions) or executed (e.g. as per pre-filing, filing or post-filing functions), and controlled through the Compliance Task Manager and its related Compliance Control Points. Dashboard elements can be defined in order to report on the quantity and quality of these business collaborations in real-time.
- Compliance Tasks [REQ.CCT.02], referring to activities associated with Compliance Control Points and their execution through the composition of Compliance Measures. It appears as a list of tasks to be executed by human or automated services. The status of those tasks can be reflected inside specific dashboard elements in order to demonstrate the completeness of compliance activities in real-time.
- Compliance Services [REQ.CCT.03], referring to activities associated with the execution of Compliance Measures by service providers, automatically or manually. The status of these activities can appear in dashboard elements in order to reflect in real-time the performance of the various service providers as well as the outcomes of specific measures reported by these services.

This explains why the Compliance Practice Enabler design pattern is itself composed of three elementary design patterns, which are the Business Collaboration Enabler Design Pattern, the Compliance Task Manager Design Pattern, and the Compliance Service Enabler Design Pattern. Those elementary design patterns are further described hereafter.

The resulting high-level view of the CCT Design Pattern is provided in Figure 9. Only pattern elements related to the CCT are represented; those related to the Data Pipeline are out of the scope of this chapter.

Figure 9: Compliance Control Tower (CCT) Design Pattern - High-level view (Archimate representation)

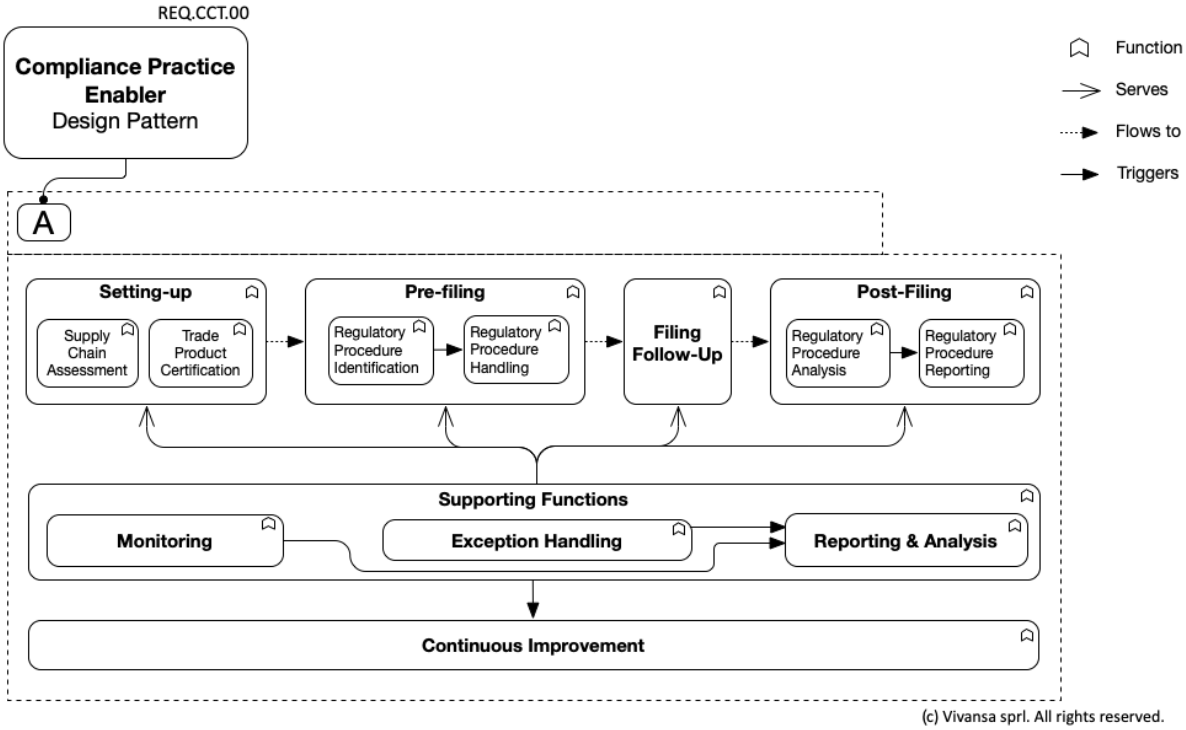


The main elementary design patterns, which constitute the CCT design pattern, are described hereafter following the A - B - C - D - E logical order.

Compliance Practice Enabler Design Pattern

The Compliance Practice enabler design pattern is the overarching architecture element which allows for the instantiation of the Customs Compliance Elementary Business Functions (EBF) defined in Chapter 4. Its Archimate representation is provided in Figure 10.

Figure 10: Compliance Practice Enabler Design Pattern - High-level view (Archimate representation).



Business Collaboration Enabler Design Pattern

The Business Collaboration Enabler Design Pattern is the architectural element that allows for Business-to-Business (B2B) relationships to be controlled and to efficiently serve compliance practices.

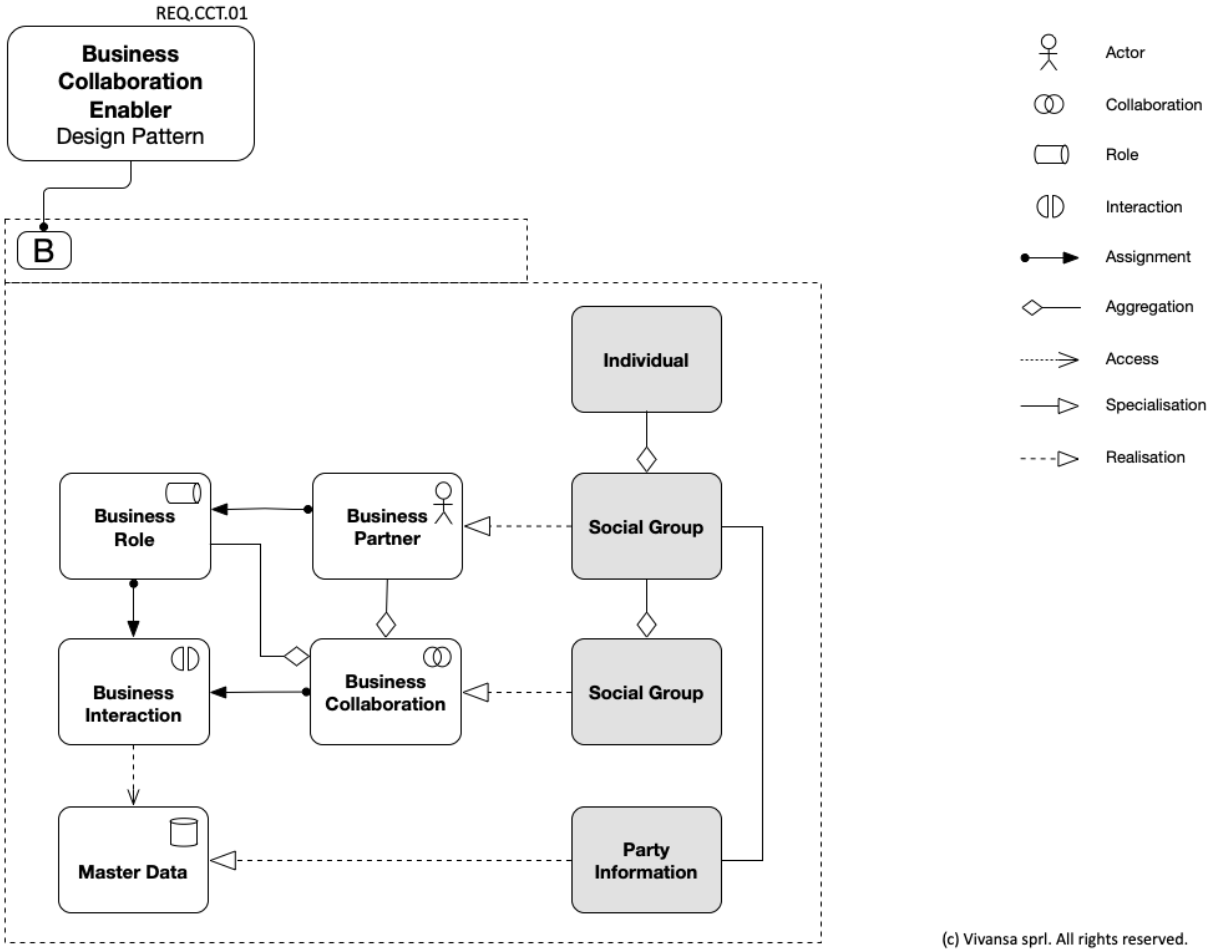
> *A business collaboration represents an aggregate of two or more business active structure elements (i.e. business parties) that work together to perform collective behaviour. Business interactions can be used to describe and execute the behaviour that takes place within a business collaboration. A business collaboration is a (possibly temporary) collection of business roles, actors, or other collaborations within an organisation which perform collaborative behaviour (interactions). Unlike a department, a business collaboration need not have an official (permanent) status within the organisation; it is specifically aimed at a specific interaction or set of interactions between roles. It is especially useful in modelling and implementing Business-to-Business interactions between different organisations, and also for describing and implementing social networks.* (Archimate, 2019)

The digitalisation of such business collaborations takes simultaneously the form of:

- Social network groups (e.g. WhatsApp), enabling informal interactions between parties, before and in support of the definition of advanced interactions or in the course of their execution.
- Ecosystem elements materialising the formal structure of organisations with their roles assigned to specific behaviours (i.e. interactions).
- Master data elements describing the "meaning" of (or detailed information about) those ecosystem elements through canonical data models, possibly in relation with existing databases (e.g. inside ERPs).

As far as global trade and customs compliance is concerned, root collaborations between parties can be identified and formalised under the form of *Tradelanes*, to be seen as a type of specialisation of these collaborations. The Archimate representation of the Business Collaboration Enabler Design Pattern is provided in (Figure 11).

Figure 11: Business Collaboration Enabler Design Pattern - High-level view (Archimate representation)



Compliance Task Manager Design Pattern

The Compliance Task Manager Design Pattern is the architectural element that allows compliance business activities (to be executed) to be identified, registered, assigned and executed in a controlled way. Any business activity (=task) stored in the backlog (= to-do list) of the Compliance Task Manager relates to a Compliance Control Point (CCP), which is a process triggered by the occurrence of a business event (e.g. an Advanced Shipment Notice (ASN) has been received). Each CCP aggregates a set of Compliance Measures (CM), which are assigned to the concerned actors of the ecosystem according to their business roles. The execution of a Compliance Measure can also be fully automated, in which case the related IT service contract and endpoint (i.e. service provider) are specified to support the automatic invocation.

Compliance Control Point

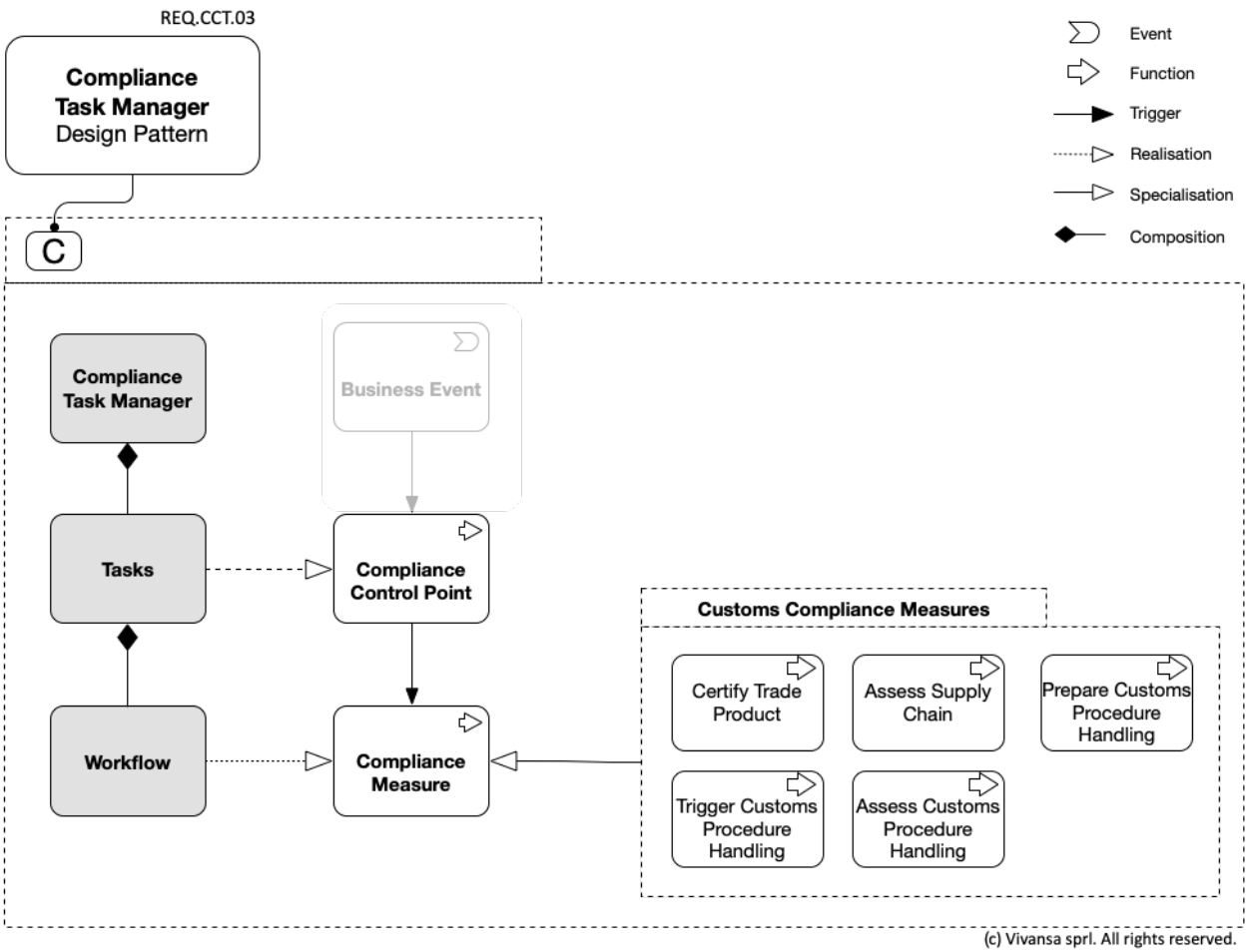
A Compliance Control Point (CCP) is a point (a step) of a business process where it is essential to control (reduce or eliminate) a risk of non-compliance (e.g. to avoid downtime, penalties, etc.). A CCP is associated with a business event (to which a business process relates or is related to) for which an assessment must be done. CCPs are business case-specific and therefore refers to specific Key Business Events that must be identified for each organisation inside its ecosystem.

Compliance Measure

A Compliance Measure (CM) is an activity (i.e. a business process) that has to be done following the assessment of a business event for which a Compliance Control Point (CCP) was set. CMs support the Compliance Functions according to the way CCPs are specified for the organisation. In the case a CM is digitised, then it shall compose 'services' as per the SOA terminology. Such (electronic) service is also called Compliance Service (CS).

The Archimate representation of the Compliance Task Manager Design Pattern is provided in (Figure 12).

Figure 12: Compliance Task Manager Design Pattern - High-level view (Archimate representation)



Compliance Service Enabler Design Pattern

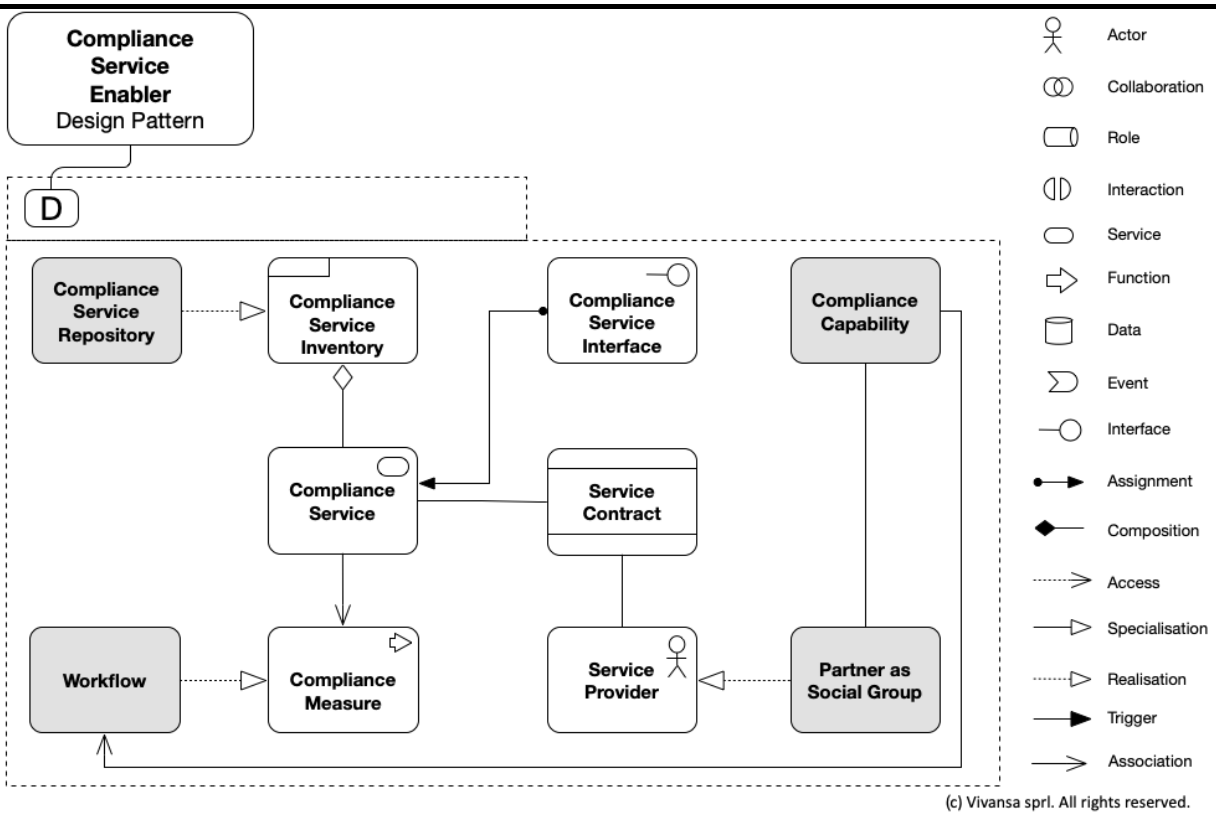
The Compliance Service Enabler Enabler design pattern is the architectural element which allows compliance activities to be executed by the most relevant parties across a complex ecosystem.

This design pattern fundamentally involves the co-existent application of the *Compliance Service* pattern and the canonical Service-Oriented Architecture (SOA) design principles and patterns. The Compliance Service Enabler Enabler design pattern relies mostly on the definition of a standardised service *contract* as a principle to offer a high level of intrinsic interoperability.

> *A contract represents a formal or informal specification of an agreement between a provider and a consumer that specifies the rights and obligations associated with a product and establishes functional and non-functional parameters for interaction. It may be used to model a contract in the legal sense, but also a more informal agreement associated with a product. It may also be or include an SLA describing an agreement about the functionality and quality of the services that are part of a product.* (Archimate, 2019)

The Archimate representation of the Compliance Service Enabler Design Pattern is provided in (Figure 13).

Figure 13: Compliance Service Enabler Design Pattern - High-level view (Archimate representation)



Instantiation of the CCT Design Pattern for Customs (CCT-C)

Based on the above design elements, it is now possible to do an instantiation of the CCT Design Pattern for the specific area of Customs, thus leading to the Compliance Control Tower *for* Customs (CCT-C) Design Pattern. At the heart of the CCT-C Design Pattern is the Customs Compliance Service Repository architecture element, which is composed of a number of Customs Compliance Services as follows:

- Tariff classification;
- Customs valuation;
- Origin calculation;
- Customs duty calculation;
- Export control;
- Customs procedure handling.

Those Customs Compliance Services are associated with Customs Compliance Measures, which are:

- Certify trade product;
- Assess supply chain;
- Prepare Customs procedure handling;
- Trigger Customs procedure handling;
- Assess Customs procedure handling.

The execution of these measures requires the ability to access Customs Regulatory Master Data, which are:

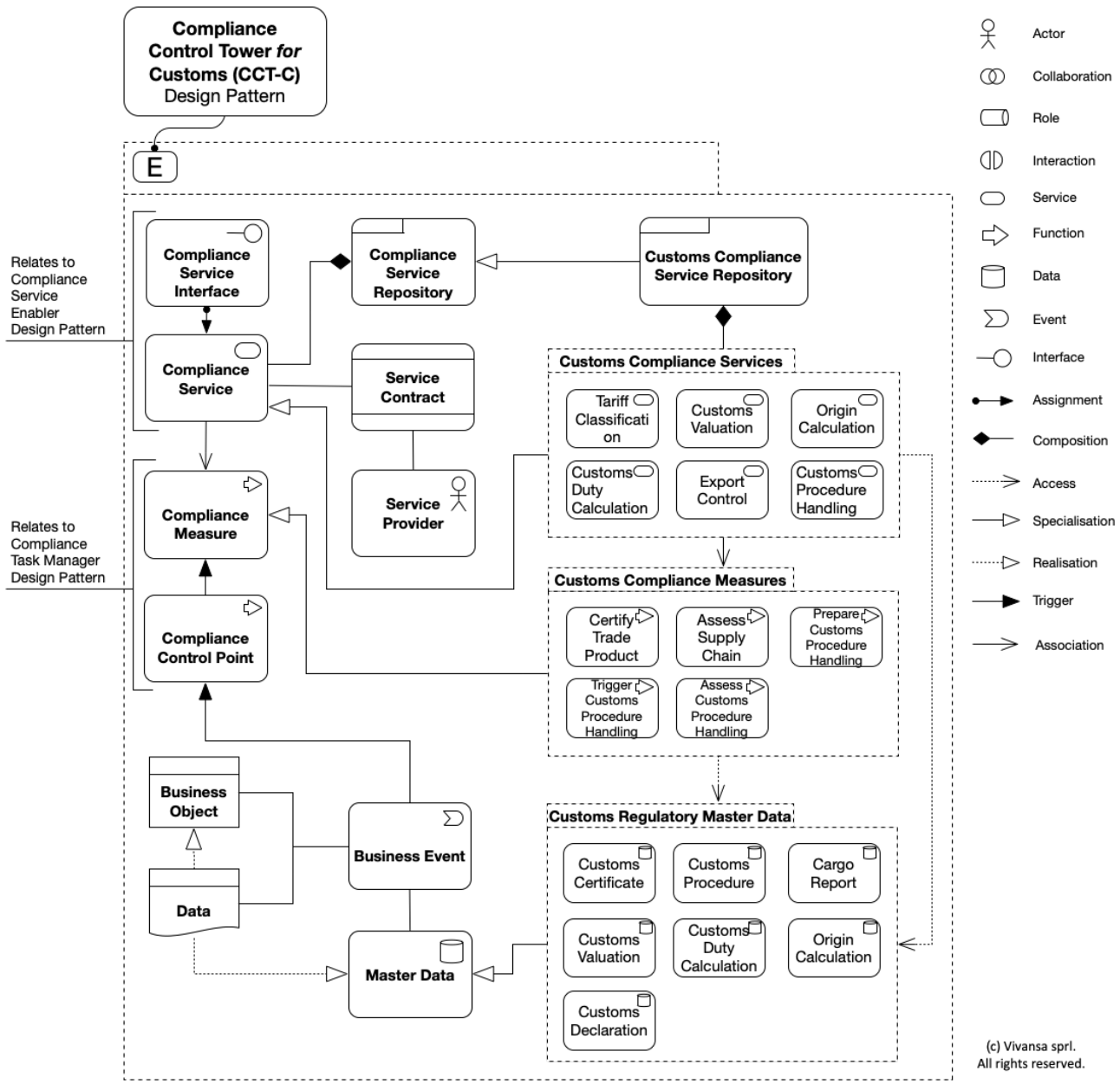
- Customs Certificate master data;
- Customs procedure master data;
- Cargo report master data;
- Customs valuation master data;
- Customs duty calculation master data;
- Origin calculation master data;
- Customs declaration master data.

The overall logic is that any business event that is relevant from the Customs compliance viewpoint triggers the execution of the related Compliance Control Point. The execution of Compliance Control Point allows capturing the Customs Regulatory Master Data and identifying the (set of) Customs Compliance Measure(s) to be executed to fulfil compliance obligations.

Those measures are associated with Compliance Services, which are enabled through the invocation of the Compliance Service Enabler Design Pattern. Those services, which may be provided in-house (using existing GTMS or ERP services) or through external (local) Service Providers, compose the Compliance Service Repository.

The Archimate representation of the Compliance Control Tower *for* Customs (CCT-C) Design Pattern is provided in (Figure 13).

Figure 14: Compliance Control Tower *for* Customs (CCT-C) Design Pattern - High-level view (Archimate representation)



Standards and Reference Technology

The table below (Table 11) provides the list of the standards and reference technology to be considered when envisaging an implementation project making use of the CCT Design Pattern. A distinction is made between those that apply to the Compliance Control Tower (CCT) itself and those that apply to the supporting Data Pipeline (DP).

Table 11: Standards and Reference Technology

Standard / Technology	Description	Applies to
World Customs Organisation (WCO) - SAFE Framework	The SAFE Framework has emerged as the global Customs community's concerted response to threats to the supply chain security, equally supporting the facilitation of legitimate and secure businesses. It prescribes baseline standards that have been tested and are working well around the globe.	CCT
World Customs Organisation (WCO) - Integrated Supply Chain Management Guidelines	ISCM guidelines have to be read in particular with the trade facilitation aspirations of the SAFE in mind. Integrated supply chains as described in these guidelines have features that distinguish them from the regular flow of goods and justify faster or immediate release/clearance of the concerned consignments. One example of such integrated supply chains is the one based on Customs-to-Customs information sharing and mutual recognition of controls. Other types of integrated supply chains include supply chains with Authorized Economic Operators (or other trusted traders) involved throughout the supply chain (trusted trade lanes).	CCT
United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT) - Multi Modal Transport Reference Data Model (MMT RDM)	This standard describes the requirements for a generic reference data model supporting the trade and transport-related processes involved in the cross border supply chain and covering at a high-level the involved business areas, the main parties and the information involved. The framework for any cross-border transport-related business and government domains to specify their own specific information exchange requirements whilst complying with the overall processes and data structures. It provides overall definitions and concepts related to cross-border supply chains in order that transport-related data exchange documents reusing and based on the adoption of these definitions and concepts can be integrated into software solutions for traders, carriers, freight forwarders, agents, banks, Customs and Other Governmental Authorities, etc.	CCT
United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT) - Data pipeline carrier - Pipeline Data Exchange Structure (PDES)	This standard outlines and standardizes the information entities of the Data Pipeline Carrier, which is based on the Multi-Modal Transport Reference Data Model (MMT RDM). The project scope is to standardize and harmonize messages related to the cross-border exchange of goods for any mode of transport to be exchanged between multiple actors within a supply chain, either directly within one or between corresponding Data Pipelines. The Data Pipeline works on the principle that in advance data from trusted sources is made available at the earliest opportunity to those that need and require the data.	DP
World Wide Web Consortium (W3C) - Semantic Web	The Semantic Web is an extension of the World Wide Web through standards set by the World Wide Web Consortium (W3C). The goal of the Semantic Web is to make Internet data machine-readable. To enable the encoding of semantics with the data, technologies such as Resource Description Framework (RDF) and Web Ontology Language (OWL) are used. These technologies are used to formally represent metadata. For example, ontology can describe concepts, relationships between entities, and categories of things. These embedded semantics offer significant advantages such as reasoning over data and operating with heterogeneous data sources. These standards promote common data formats and exchange protocols on the Web, fundamentally the RDF. According to the W3C, "The Semantic Web provides a common framework that allows data to be shared and reused across application, enterprise, and community boundaries." The Semantic Web is therefore regarded as an integrator across different content and information applications and systems.	DP

ArchiMate® Enterprise Architecture modelling language	The ArchiMate® Enterprise Architecture modelling language provides a uniform representation for diagrams that describe Enterprise Architectures. It includes concepts for specifying inter-related architectures, specific viewpoints for selected stakeholders, and language customization mechanisms. It offers an integrated architectural approach that describes and visualizes different architecture domains and their underlying relations and dependencies. Its language framework provides a structuring mechanism for architecture domains, layers, and aspects. It distinguishes between the model elements and their notation, to allow for varied, stakeholder-oriented depictions of architecture information. The language uses service-orientation to distinguish and relate the Business, Application, and Technology Layers of Enterprise Architectures and uses realization relationships to relate concrete elements to more abstract elements across these layers.	CCT DP
Service Oriented Architecture (SOA) Principles and Design Pattern	Service-oriented architecture (SOA) is a style of software design where services are provided to the other components by application components, through a communication protocol over a network. An SOA service is a discrete unit of functionality that can be accessed remotely and acted upon and updated independently, such as retrieving a credit card statement online. SOA is also intended to be independent of vendors, products and technologies. Different services can be used in conjunction to provide the functionality of a large software application, a principle SOA shares with modular programming. Service-oriented architecture integrates distributed, separately maintained and deployed software components. It is enabled by technologies and standards that facilitate components' communication and cooperation over a network, especially over an IP network. Interestingly, all SOA Design Patterns are gathered within a single catalogue published by Arcitura.	CCT DP

Bottom Line

This chapter has allowed describing the Compliance Control Tower (CCT) concept, to derive (from the analysis conducted in Chapter 4) the list of requirements establishing the foundation of the CCT Design Pattern, to produce the design of CCT Design Pattern, and apply it to the specific area of Customs (CCT-C). The CCT Design pattern can now be handed over to IT analysts and compliance field experts for further evaluation activities. This will be the objective of the next chapter (Chapter 6).

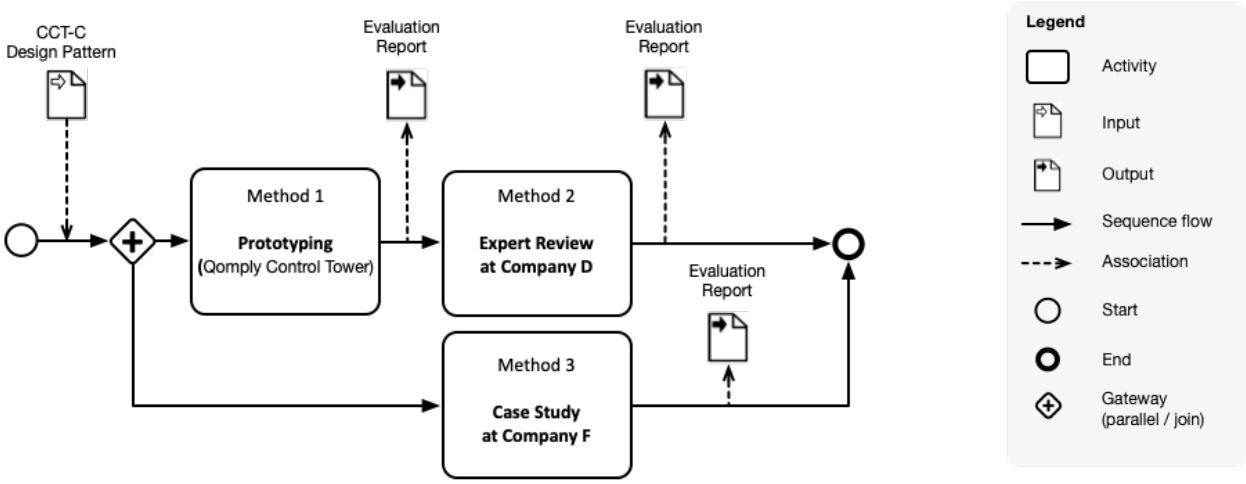
Chapter 6 – Evaluation

Introduction

This chapter is focused on the evaluation of the research artefact, namely the Compliance Control Tower *for* Customs (CCT-C) Design Pattern. The intention is to evaluate the CCT-C Design Pattern designed in Chapter 5 in terms of its potential to address the misfit reported by compliance practitioners (cf. Problem Statement).

As illustrated in Figure 15, the evaluation process makes a concurrent usage of three different methods: prototyping, expert review, and case study. The reason for using different methods is essentially driven by the initial intention to associate users – the compliance practitioners – as much as possible to the evaluation process, as user involvement is likely to result in increased user satisfaction and the perceived usefulness of the artefact (cf. User Participation in the Design Process and Evaluation).

Figure 15: CCT-C Design Pattern evaluation - Overall process (BPMN representation)



Customs Compliance Tower Prototyping

Introduction

In order to validate the CCT-C Design Pattern, the decision was made quite early in the artefact design process to undertake a (physical) prototyping activity by means of software development under the codename **Qomply®**.

The interest in conducting such prototyping is that it plays an important role in illustrating and communicating functionality. Berglund, A. & Leifer, L. (2013) emphasize that the simplicity and usability of physical prototyping account for its strength in helping teams to make the intangible – the CCT-C Design Pattern – tangible.

Prototyping supports idea generation, conceptualisation, design exploration, evaluation, communication, and construction. Because it can be an overwhelming undertaking to create a single prototype that strives to achieve all of these goals, it is important to be focused on objectives.

Therefore, in the scope of this thesis, the focus has been put on two key objectives:

1. **Implementability**. To demonstrate that the CCT-C Design Pattern is *implementable* in the sense that its current formalisation can be understood by IT analysts and handed over to IT teams for conducting developments activities.

2. **Relevance**. To validate that the implemented functionality would potentially meet the requirements of target users (i.e. the compliance practitioners) in terms of providing the necessary control over their compliance operations, should the prototyping be subject to pilot testing in a live environment.

Qomply® Control Tower Prototype

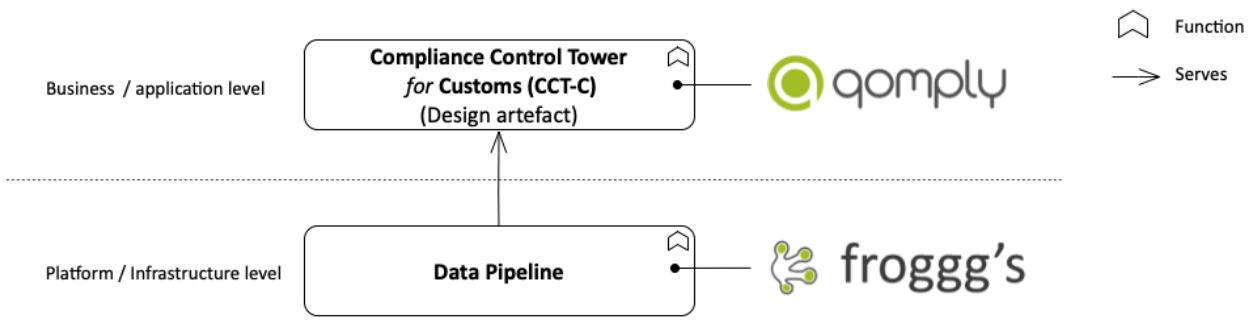
The approach of the prototyping has been to make a clear distinction between the CCT layer and the Data Pipeline layer. Indeed, if those two layers would be merged into a single layer, then the consequence would be the Compliance Control Tower to become yet another silo, hard to integrate and evolve (this is an issue commonly encountered by so-called *digital platforms* and, as highlighted in Chapter 4, GTMS portfolios very often meet such pitfall).

The resulting prototyping implementation, therefore, consists of two main components, respectively named Qomply® and Froggg's®, as illustrated in Figure 16:

1. Qomply is the application which implements the Compliance Control Tower function using the CCCT-C Design Pattern (the artefact of the research)

2. Froggg's[30] is the middleware which implements the Data Pipeline function.

Figure 16: CCT-C design pattern evaluation - Qomply® Control Tower (Archimate representation)



Prototype evaluation process

The prototyping activity carried out within the framework of this thesis took place between the March-August 2020 period. To that aim, the firm Vivansa[31] mobilised a small development team composed of one experienced Enterprise Architect, one lead analyst/developer, and one SysOps engineer.

Figure 17 describes the process adopted to perform the prototyping-based evaluation of the CCT-C Design Pattern. Prototyping being an iterative process by nature, six iterations were achieved over the full activity, each one allowing to refine the functional and technical specifications of the prototype. Each iteration was subject to an evaluation[32] by one field expert.

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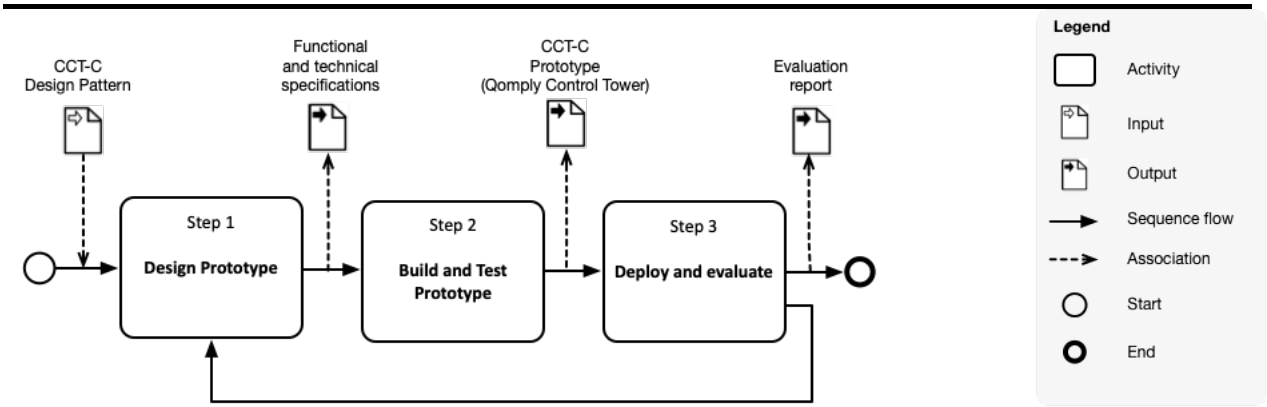
[30] Froggg's® (www.frogggs.com) is a short for Federating Relationship on the Giant Global Graph. Froggg's is a trademark of Froggg's S.A., a Vivansa's spin-off company established in the Luxembourg City Incubator (LCI) of start-ups since 2018. The motivation behind the development of the Froggg's platform is to offer a free, open source, accessible anytime, anywhere Data Pipeline.
Froggg's is meant to facilitate the collaboration across multiple business ecosystems by:

- Connecting People through its 'Collaboration Enabler' because people have to agree with each other before machines can actually interact.
- Linking Data through its 'Semantic Enabler' because data models and formats are not universal by nature, meanings should be.
- Composing Services through its 'Service Enabler' because the business capabilities of an organization should be exposed through well-defined service contracts and intrinsically interoperable & distributed interfaces in order to dynamically compose business processes.

[31] Vivansa is a company specialised in the field of electronic Customs. More information at www.vivansa.com.

[32] The evaluation track record is subject to a clause of confidentiality. However it could be provided upon duly motivated request.

Figure 17: CCT-C design pattern evaluation - Qomply® prototype evaluation process (BPMN representation)



Outcome of the evaluation

As far as the CCT-C Design Pattern *implementability* is concerned, the evaluation shows that the Qomply® Control Tower could actually implement the most important elementary design patterns entering into the composition of the CCT-C Design Pattern, i.e. the Business Collaboration Enabler Design Pattern, the Compliance Task Manager Design Pattern, and the Compliance Service Enabler Design Pattern.

The evaluation report provided in Appendix C indicates a 58% completeness rate, which is a fair indicator given the limited timeframe allowed to the prototyping activity. The evaluation report shows that the Qomply® implementation (i.e. CCT layer) highly benefited from the availability of the Froggg's middleware (Data Pipeline layer), which has contributed to facilitate and speed up the implementation process.

There are, however, key items for which implementability aspects require further investigations:

1. REQ.CCT.07 Compliance service - The ability to connect services[33] offered by external Customs-related IT service providers needs to be further investigated (completeness rate is .15).
2. REQ.CCT.06 Compliance Measure (CM) - The process through which the (set of) compliance measures addressing a specific Customs compliance requirement are identified and codified needs to be further investigated (completeness rate is .20).
3. REQ.CCT.04 Make use of Tradelanes - The formalisation of tradelanes according to the UN/CEFACT Multi-Modal Transport Reference Data Model (2018) needs to be further investigated (completeness rate is .30).

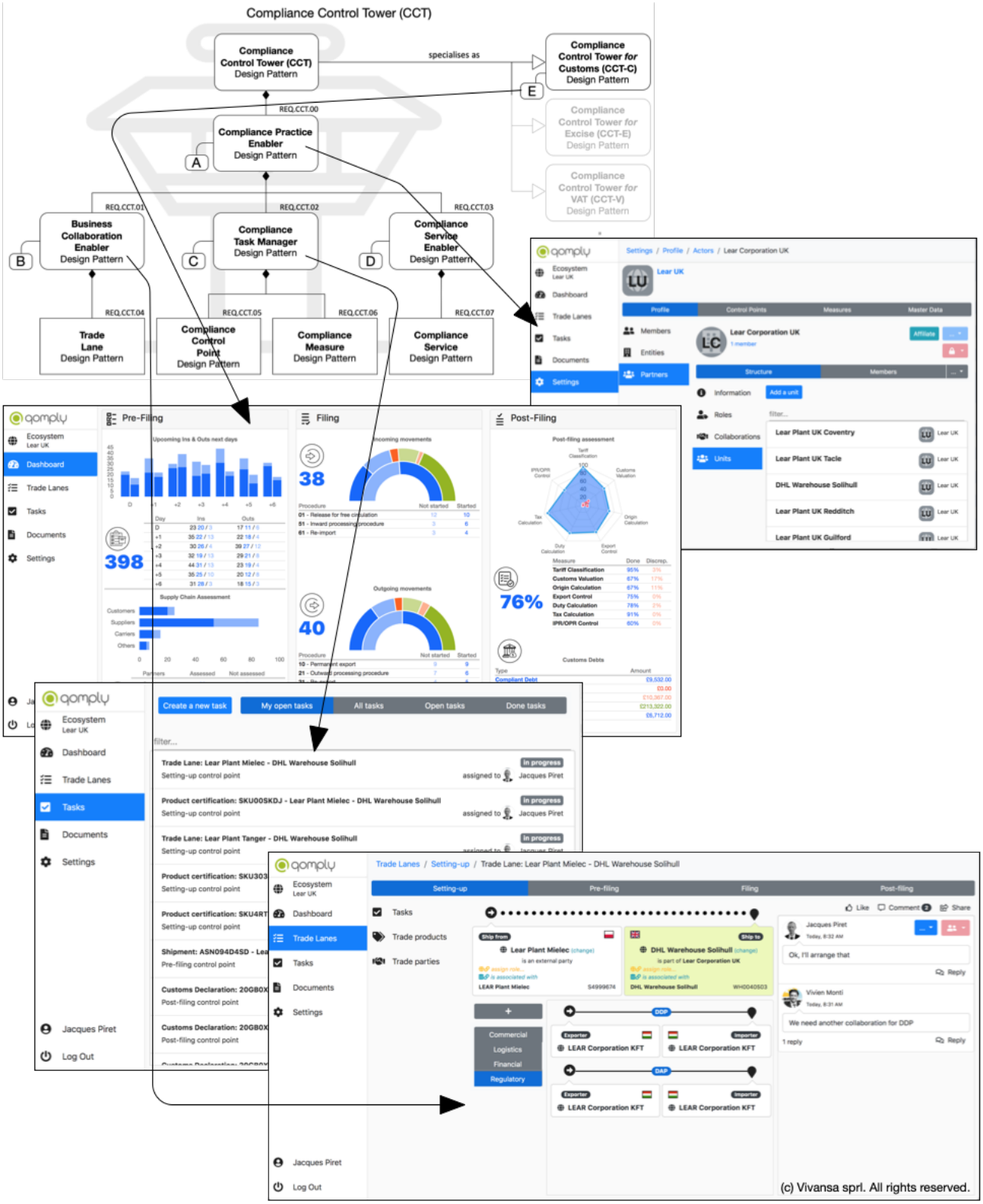
As far as the CCT-C Design Pattern *relevance* is concerned, the evaluation shows that developed Graphical User Interface (GUI) offers a strong potential to provide compliance practitioners with the necessary control and visibility over their Customs compliance operations.

Most of the elementary business patterns entering into the composition of the CCT Design Pattern fit nicely in the interface as illustrated in Figure 18.

However, the interface has been evaluated by only one Customs field expert so far and, undoubtedly, a larger number of reviewers would be required to be able to assert the validity of the pattern in terms of relevance to the business.

[33] These are the Customs-related services offered by the 3rd Party Logistics providers (3PLs) participating in the business ecosystem of the focal organisation. Usually, these 3PLs make use of IT facilities provided by (external/local) IT Service Providers, such as origin calculation, tariff classification, customs valuation, customs duty calculation, electronic declaration filing, etc. A (non-exhaustive) list of IT Service Providers is provided in Appendix B.

Figure 18: CCT-C design pattern evaluation - Evaluation of the Qomply® prototype - Relevance of the pattern.



Expert Review at Company D

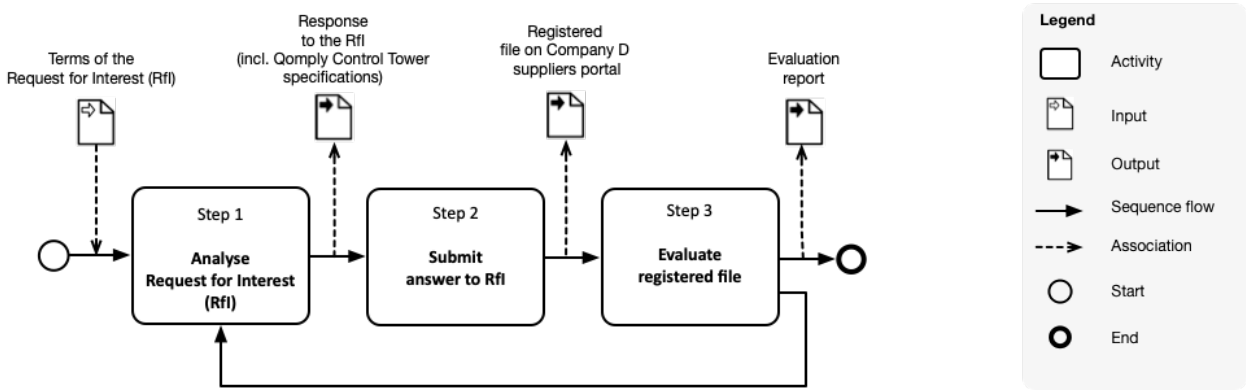
Introduction

Company D is a major player in the Tyre manufacturing industry. Taking advantage of the availability of the Qomply® Control Tower functional and technical specifications (which were produced during the prototyping activity), Vivansa has been invited by Company D to participate to a Request for Interest (RfI) aiming at selecting a number of candidate companies for the implementation of a Worldwide Control Tower. The initial objective is to take advantage of the facilities offered by the Compliance Control Tower to achieve a major rationalisation of the 3PLs working with Company D across the world. The primary focus is at post-filing time, but other elementary business functions should enter into the scope of the project at a later stage. Therefore, this RfI has been a great opportunity for Vivansa to have the Qomply® Control Tower specifications being evaluated by a pool of experts at Company D.

Expert review process

The review took place in June 2020 and has been carried out by a pool of experts at Company D composed of ICT architects and trade compliance practitioners. Figure 19 describes the process which was applied to have the Qomply® Control Tower specifications submitted for expert review at Company D.

Figure 19: CCT-C design pattern evaluation - Expert review of the Qomply® Control Tower specifications.



Scope of the expert review

The evaluation performed by the Company D expert committee focused on three categories of requirements: General Requirements (GR), Functional Requirements (FR), and Non-Functional Requirements (NFR). The detailed content of the review is provided in Appendix C – Expert Review of Qomply® Control Tower Specifications.

Outcome of the expert review

Table 12 provides the outcome of the evaluation performed by Company D. The evaluation of the Qomply® Control Tower specifications resulted in an outstanding level of compliance (100%) with the requirements set by Company D. However, this result must be put into perspective by the facts that:

1. The requirements of the RfI were not very stringent in terms of functional scope (i.e. limited to post-filing function only);
2. The evaluation has been focused on the Qomply® Control Tower specifications only and not on the prototype, which is obviously a limiting factor to assert the relevance of the solution from a usability perspective.

Therefore, further evaluation work will be required to envisage a pilot implementation at Company D. Vivansa being among the (3) shortlisted companies, a second evaluation phase focused on establishing a Proof of Concept is planned in Q4/20. This will be the opportunity to demonstrate the Qomply® Control Tower prototype in a test environment at Company D.

Table 12: Evaluation of the Qomply® Control Tower Specifications (Company D)

CCT Prototype - Expert Review Check-list		Passed? (Yes/No)
General Requirements		
GR.01	Regain control and optimize export and import customs data	Yes
Functional Requirements		
FR.01	Ability to be fed and/or connected to all Company D's brokers	Yes
FR.02	Ability to cope with variable IT capabilities of Brokers	Yes
FR.03	Ability to support all languages used by brokers (Chinese, roman, Cyrillic, etc.)	Yes
FR.04	Ability to connect other Global Trade Management Software (GMTS) already in use with Company D	Yes
FR.05	Ability to generate automatic tasks and alerts	Yes
FR.06	Provide duty savings dashboard facilities	Yes
FR.07	The flow of alerts, answers, modification, etc. must be archived and made accessible	Yes
FR.08	Ability to set KPIs, to search for KPIs, to display KPIs	Yes
Non-functional Requirements		
NFR.01	Ability of the Control Tower to be adaptable and extensible (for business needs and technology evolution)	Yes
NFR.02	The access to the Control Tower must be secure	Yes
NFR.03	IT servers hosting the Control Tower should not be located in the USA or subjected to the US regulations such as the US Nexus	Yes
NFR.04	If use of collaborative platform, connections should be free of charge	Yes

Case study at Company F

Introduction

Company F is a major player in the automotive industry. Company F is facing the challenge to adapt to the regulatory changes caused by Brexit. In this context, Vivansa experts were mandated to identify a possible solution allowing Company F practitioners to keep control over Customs compliance operations in this new context. Therefore, this activity has been another opportunity to apply the CCT-C Design Pattern to address this specific case.

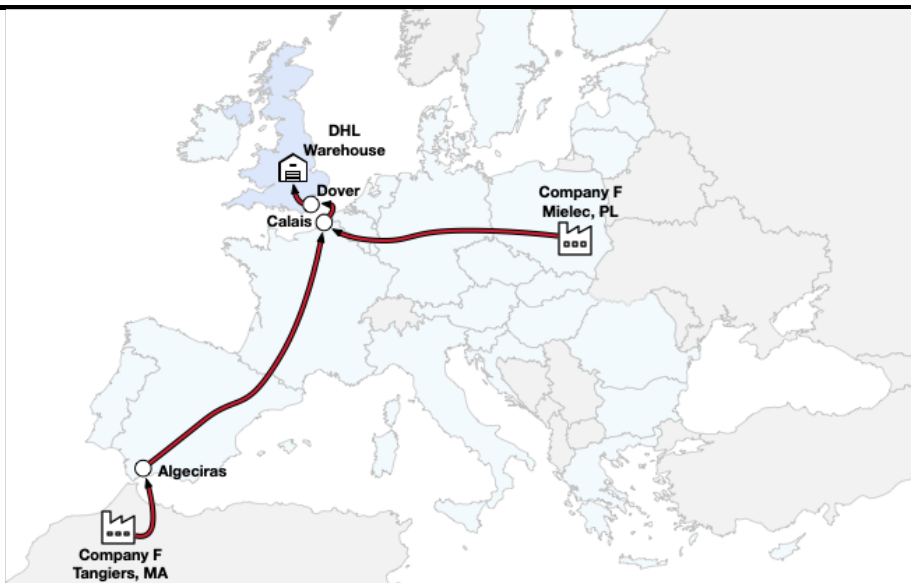
Scope of the case study

The case study concerns the so-called 'E-Systems flows' seen from a UK perspective. These flows refer to the business processes driving the deliveries of electronic parts produced by Company F plants (located outside the UK) to UK customers. These UK customers are both Company F and non-Company F customers. Company F Customers in the UK are seating-related Tier-1 plants (Coventry, Redditch and Sunderland), which use these electronic parts for seat manufacturing.

The 'E-Systems flows' involve the usage of a warehouse in the UK belonging to the DHL company and used by Company F to store E-Systems parts. This warehouse is identified as the 'DHL warehouse'. The E-Systems parts entering into the scope of this case are those produced and shipped by Company F plants located in Poland (Mielec) and Morocco (Tangiers), as illustrated in Figure 20.

The objective of this analysis is to define a solution that would allow the 'E-Systems flows' to be fully in control from a Customs compliance point of view in the situation where Brexit is effective.

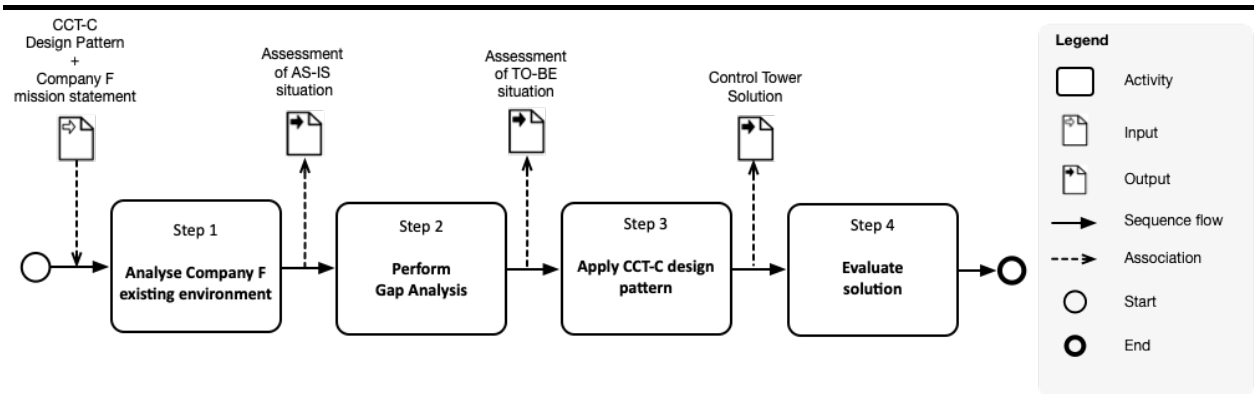
Figure 20: CCT-C design pattern evaluation - Scope of the case study at Company F



Case study process

The activity took place during the period of February 2020 - July 2020. The activity involved two Vivansa experts (i.e. one Enterprise Architect and one Trade & Customs compliance advisor) in close contact with members of Company F trade department. Figure 21 describes the process which was applied to have the Qomply® Control Tower specifications submitted for expert review at Company D.

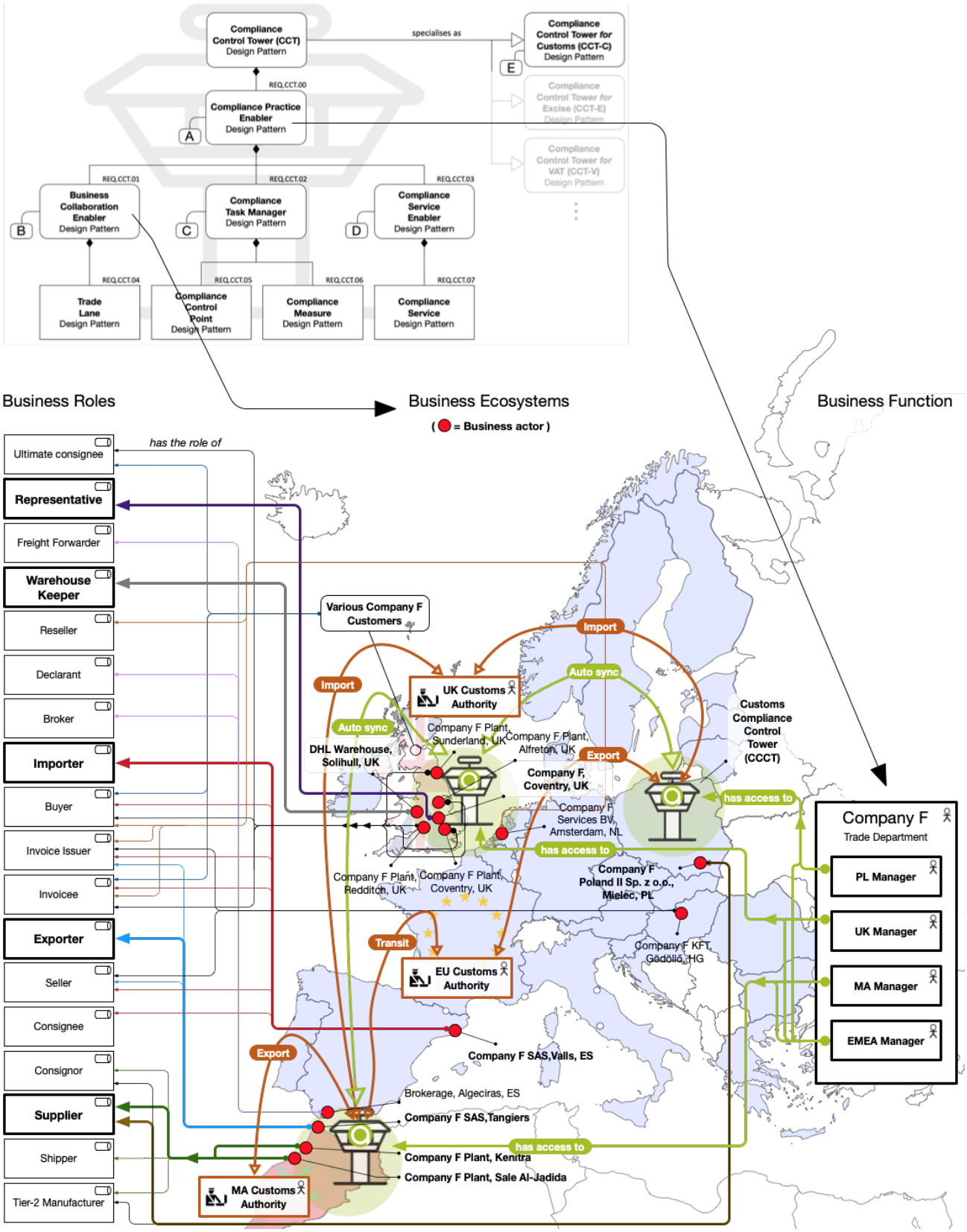
Figure 21: CCT-C design pattern evaluation - Case study process



Outcome of the case study

The case study confirmed that a Control Tower solution built upon the CCT-C Design pattern could effectively answer the requirements of Company F. The recommended approach is to consider three distinct business ecosystems (Company F - UK, Company F - Poland, and Company F - Morocco) interacting with each other. Each business ecosystem is characterised by a focal organisation and a number of partner entities (e.g. 3PLs, broker, warehouse keeper, etc.). The focal organisation is the 'owner' of the Control Tower instance and, therefore, is the primary beneficiary of the compliance services provided by the Control Tower. The focal organisation is composed of one main entity (e.g. Company F UK ltd) and a number of operational units (e.g. all Company F UK plants). The evaluation of the proposed approach confirmed its remarkable potential to address the specific needs of the 'E-Systems flows', in particular, due to the flexibility it offers to streamline interactions between business ecosystems. The proposed solution overview is provided in Figure 22 (together with links to the CCT-C Design Pattern).

Figure 22: CCT-C design pattern evaluation - Outcome of the Case study.



Bottom line

The Customs Compliance Tower (CCT) design pattern was evaluated in this chapter using three methods: prototyping, expert review analysis, and case study. The prototyping revealed that the CCT-C design pattern is *implementable* in the sense that its formalisation can be understood by IT analysts and handed over to IT teams for conducting developments activities. The developed interface also provides fair indications with regards to the relevance of the CCT-C Design Pattern in terms of *relevance* to the business. The Expert Review at Company D and the Case Study at Company F have also contributed to demonstrate the relevance of CCT design pattern to provide compliance practitioners with the necessary control over their compliance operations. It is, however, too early to conclude on full applicability of the proposed pattern to address all data integration issues reported by the practitioners (cf. Assessment of Customs compliance practices at several MNEs (survey)) and further evaluation work involving a larger audience of practitioners needs to be carried out to progress in this direction.

Chapter 7 – Conclusion

Introduction

This chapter summarizes the thesis and discusses the contributions it has made towards research and practice. Then, it concludes with a discussion of the thesis limitations and future directions of research.

Discussion

The assessment of the problem statement relevance realised in Chapter 4 confirms that MNEs' compliance practitioners are struggling to get the necessary control over their compliance operations, which appear not to be optimally supported by current GTMS implementations.

The research activities conducted concurrently on the assessment of Customs compliance practices at several MNEs, the Customs Compliance Function, and the GTMS market, allow concluding that neither the GTMS customisation nor the adaptation of the company internal processes to the GTMS is likely to produce any tangible benefits to improve the situation. There are three main reasons for this:

- Customs compliance due to its extreme local specialisation remains a major obstacle for GTMS to become truly global and to cover all the needs of MNEs. MNEs are anyway required to rely on local solutions that coexist with the GTMS, which is not without creating complex data integration issues;
- The highly segmented GTMS market results in MNEs to approach GTMS products in a piecemeal fashion, which is an obstacle for GTMS to deliver their full potential;
- GMTS portfolios remain siloed and do not fit well with the cross-cutting nature of the Customs compliance function, which requires effective collaboration between multiple stakeholders. Therefore, supposedly best practices promoted by GTMS vendors are likely to be inoperative to address the requirements of the Customs compliance function.

Faced with this problematic situation which has been going on for a long time, this thesis suggests a change of paradigm: instead of trying to break silos (e.g. by replacing or evolving existing GTMS), the objective should be to connect them effectively and think in terms of business ecosystems as a new way to organise the collaborations with all the stakeholders (both internally and externally) participating to the achievement of Customs compliance.

To achieve this objective there is a need for an intermediary component able to support business collaborations and federate existing assets inside and outside the organisation so as to provide MNEs practitioners with the necessary control over their compliance operations.

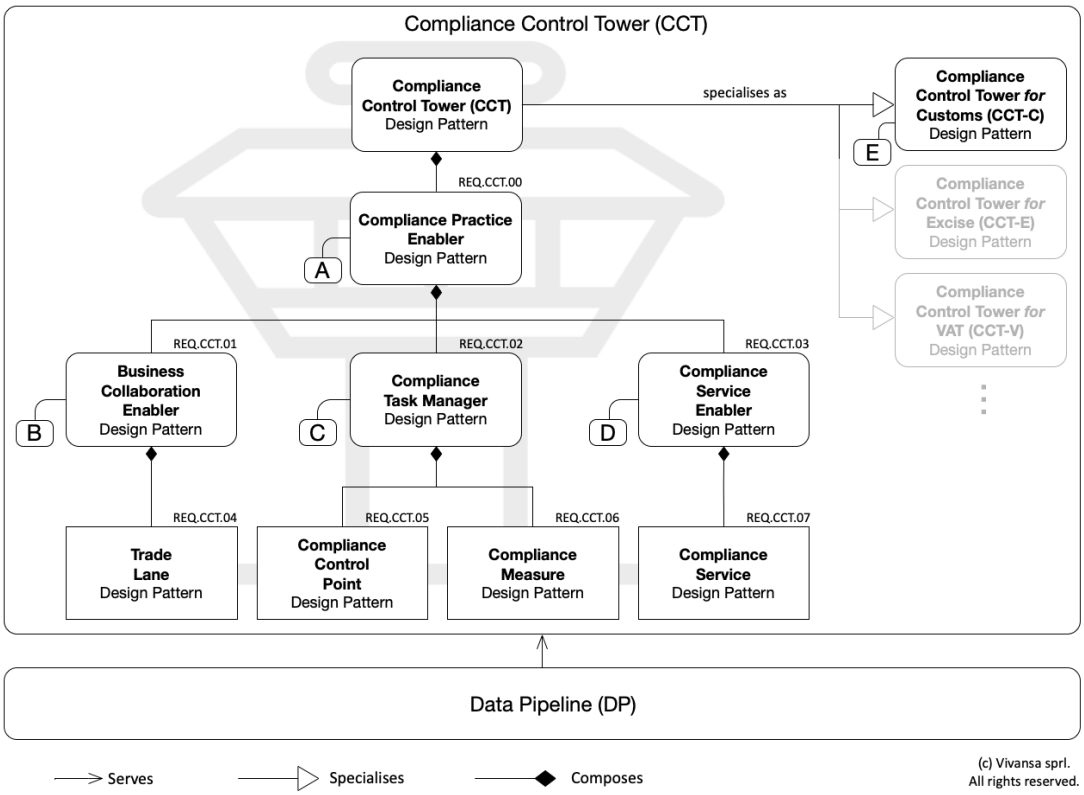
Armed with the business requirements formalised in Chapter 5 - Artefact Design, this thesis made possible to develop the concept of Compliance Control Tower (CCT) playing the role of this intermediary component and to produce the design of an artefact establishing its foundation – namely the Compliance Control Tower Design Pattern. To avoid the CCT becoming yet another silo, a clear distinction between the CCT upper (business) layer and the Data Pipeline lower (data integration) layer is made. This is key to confer to the CCT its federative nature and to enable effective business collaborations despite vendor lock-in situations encountered in MNEs.

The Compliance Control Tower design pattern is the architectural element that allows trade compliance to be accurately controlled inside complex business ecosystems. This pattern allows for various functional specialisations such as Customs, excise, VAT, and others. It offers a generic template format so that it can be repeatedly applied in various IS implementations, thus facilitating the digitalisation of the Customs compliance function. It can also be combined into compound patterns to solve larger problems. Being primarily focused on Compliance practices [REQ.CCT.00] the CCT design pattern is composed by the Compliance Practice Enabler design pattern and, at run time, is meant to provide visualisation and decision-support facilities (through dashboards) according to the roles and responsibilities of the involved parties.

The evaluation of the Compliance Control Tower Design Pattern, which was made using three different methods (prototyping, expert review, and case study), has shown that the pattern offers a remarkable potential to address the problem statement. The prototyping revealed that the CCT-C design pattern is implementable in the sense that its formalisation can be understood by IT analysts and handed over to IT teams for conducting developments activities.

The developed interface also provides fair indications with regards to the relevance of the CCT-C Design Pattern in terms of relevance to the business. The Expert Review at Company D and the Case Study at Company F have also contributed to demonstrate the relevance of CCT design pattern to provide compliance practitioners with the necessary control over their compliance operations.

Figure 23: Compliance Control Tower (CCT) Design Pattern.



Contributions of the Thesis

Contribution to Research

The Literature review has highlighted that the Customs compliance function remains widely undocumented. The Assessment of the Customs Compliance Function, which was done in Chapter 4, contributes to filling this knowledge gap. This contribution has consisted in proposing a definition for Customs compliance, to formalise the Customs compliance Elementary Business Functions, to inventory the list of Customs compliance business activities, and to reveal the cross-cutting nature of the function by identifying Customs compliance business actors and the related ecosystem-based Customs Compliance business collaborations.

A major outcome of this contribution is the clarification that it brings in terms of the *necessary control* that any digitalisation initiative is meant to bring to the compliance practitioners. Actually, to bring the *necessary control* over compliance operations, any digital implementation should be able to support:

1. All identified Customs compliance Elementary Business Functions (the 'workflow' of the practices);
2. All horizontal Customs compliance business collaborations between multiple actors, both internal and external (the 'ecosystem' of the practices);
3. All identified Customs compliance business activities (the practitioners 'to-do list');
4. All required Customs compliance services (either provided in-house or by external Customs-related Service Providers (CRSP)) allowing to execute the identified tasks (the 'execution' of the practices).

Implementations (whether it concerns GTMS or ERPs) which only partially support those requirements are likely to fail in providing compliance practitioners with the necessary control over their compliance operations.

Contribution to Practice

The Customs compliance practice is likely to benefit from the CCT Design Pattern in various ways:

- At planning time, the CCT Design Pattern would help assess whether an existing (or planned) Information System complies with the key elements of the pattern or not. MNEs decision-makers in charge of establishing digitalisation roadmaps for their organisation would then be able to consider digitalisation options driven by the resolution of the identified gaps. It is anticipated that such an approach would allow reducing the risk that the chosen digitalisation option does not produce the expected effect in terms of providing compliance practitioners with the necessary control over their Customs compliance operations.
- At design/build time, the CCT Design Pattern could be handed over to IT analysts and IT developers so that they can incorporate this pattern in their developments, thus facilitating the Business / IT alignment of Customs compliance-related solutions.
- A runtime, the instantiation of the CCT Design Pattern would allow practitioners (the 'human systems users') to be guided with context-relevant instructions (in real-time, with real data and information) that are adapted to their cognitive abilities and background knowledge (i.e., instructions they can understand and use to achieve compliance).

Limitations and Future Work

Expert Review

Despite the significant work which was carried out so far to evaluate the relevance of the CCT-C Design Pattern, it is, however, too early to conclude on full applicability of the proposed pattern to address all data integration issues reported by the practitioners (cf. Assessment of Customs compliance practices at several MNEs (survey)) and further evaluation work involving a larger audience of practitioners needs to be carried out to progress in this direction. This will depend mainly on the interest that the industry and the academic community will take in this innovation.

Data Pipeline

As highlighted in the key requirements establishing the design foundation of the Compliance Control Tower, a number of requirements apply to the (low-level) layers implemented by the Data Pipeline. When implementing a Compliance Control Tower, it is therefore important to make sure that the chosen Data Pipeline meets these requirements. It is also important to verify that the (commercial) policy of chosen pipeline does not represent an obstacle to its accessibility and generalisability to a potentially high number of actors taking part in the business ecosystem. Even if Data Pipelines are meant to be interoperable 'by design', there is no clear evidence of such operability among the current initiatives launched in this field. The risk is therefore that the lack of a truly open, SOA-based, interoperable, access-free, data pipeline infrastructure limits the possibility of the Compliance Control Tower concept to become truly effective. The Froggg's initiative (that the prototyping activity has been able to benefit from) is meant to address this kind of issue. Further investigations in this field would certainly help for the adoption of Compliance Control Towers by MNEs to become truly global.

Acronyms

CCT	Compliance Control Tower
CCT-C	Compliance Control Tower - Customs
CCEF	Customs Compliance Elementary Functions
CCF	Customs Compliance Function
CCM	Customs Compliance Measure
CCS	Customs Compliance Services
CEP	Complex Event Processing
DPE	Digital Platform and Ecosystem
EBF	Elementary Business Function
ERP	Enterprise Resource Planning
FTA	Free Trade Agreement
GTMS	Global Trade Management Software
IS	Information System
MDM	Master Data Management
MNE	Multi-National Enterprise
SOA	Service Oriented Architecture

References

Aberdeen Group. (2006). Supply chain visibility roadmap. Retrieved from http://www.aberdeen.com/ aberdeen-library/3609/RA_Visibility_BE_3609. aspx

Adner, R. (2016). Ecosystem as Structure: An Actionable Construct for Strategy. Journal of Management Vol. 43 No. 1, January 2017 39–58 DOI: 10.1177/0149206316678451

Altman, D. G. & Bland, J. M. (1999). Measuring agreement in method comparison studies. STATISTICAL METHODS IN MEDICAL RESEARCH 8, no. 2, (1999): 135-160.

Andersson, U. & Forsgren, M. (1996). Subsidiary embeddedness and control in the multinational corporation. International Business Review 5 (5) 487–508.

Amit, R. & Zott, C. (2001). Value creation in E-business. Strategic Management Journal, Vol. 22 Nos 6/7, pp. 493-520

Arsyida, T., van Delft, S., Rukanova, B. & Tan, Y.-H. (2017). Trade and compliance cost model in the international supply chain. WCO PICARD Conference, 26-28 September 2017, Hammamet, Tunisia

Ashton, W. (2008). Understanding the Organization of Industrial Ecosystems. A Social Network Approach. Journal of Industrial Ecology Volume 12, Number 1 DOI: 10.1111/j.1530-9290.2008.00002.x

Bacharach, S. B. & Lawler, E. J. (1980). Power and Politics in Organizations. The Jossey-Bass Social and Behavioral Science Series, Jossey-Bass, San Francisco, 1980.

Basili, V., Selby, R. W., & Hutchens, D. (1986). Experimentation in software engineering. IEEE Transactions on Software Engineering, vol. 12, no. 07, pp. 733-743, 1986. doi: 10.1109/TSE.1986.6312975

Berglund, A. & Leifer, L. (2013) Why we Prototype! An International Comparison of the Linkage between Embedded Knowledge and Objective Learning, Engineering Education, 8:1, 2-15, DOI: 10.11120/ened.2013.00004

Bloomberg, J. (2018). Digitization, Digitalization, And Digital Transformation: Confuse Them At Your Peril. Full article. Enterprise & Cloud, Forbes

Boella, G., Janssen, Hulstijn, J., M., Humphreys, L. & van de Torre, L. (2013). Managing Legal Interpretation in Regulatory Compliance. International Conference on Artificial Intelligence and Law 2013 (ICAIL)

Branch, A. E. (2009). Global Supply Chain Management and International Logistics. Routledge: New York etc.

Brooke, M.Z. (1984). Centralization and Autonomy: A Study in Organization Behaviour. Praeger Special Studies, Holt Rinehart and Winston, London.

Brown, T. (2009). Change By Design. New York: Harper Collins.

Buckley, P. J. & Ghauri P. N. (2004). Globalisation, economic geography and the strategy of multinational enterprises. Journal of International Business Studies 2004 35, 81–98 & 2004 Palgrave Macmillan Ltd.

Burgemeestre, B., Hulstijn, J. & Tan, Y.-H. (2011). Value-based argumentation for justifying compliance. Artif Intell Law 2011 19:149–186 DOI 10.1007/s10506-011-9113-4

Business Process Model and Notation (BPMN) version 2.0.2 (2014). Object Management Group. http://www.omg.org/oceb-2/

Bussen, W. & Myers, M. D. (1997). Executive information system failure: a New Zealand case study. Journal of Information Technology (1997) 12, 145±153

Carlsson, C. (2017). Decision analytics—Key to digitalisation. http://dx.doi.org/10.1016/j.ins.2017.08.087 0020-0255/© 2017 Elsevier Inc.

Ciborra C. & Hanseth, O. (2000). Introduction of 'From Control to Drift', Oxford, UK, Oxford University Press, 2000, pp. 1–12.

Coyle, J. J., Langley, C. J., Novack, R. A. & Gibson, B. (2016). Supply chain management: a logistics perspective. Cengage Learning, 2017

Crittenden, A. B., Crittenden, V. L. & Crittenden W. F. (2019). The digitalization triumvirate: How incumbents survive. Kelley School of Business, Indiana University, Elsevier Business Horizons 2019 62, 259-266.

Cuthill, M. (2002). Exploratory Research: Citizen Participation, Local Government, and Sustainable Development in Australia. Sustainable Development 10 (2002): 79-89.

Deloitte's Customs and Global Trade Management Benchmarking Survey Report - Untapped potential. (2017). Deloitte Development LLC. https://bit.ly/2Q0CHa7

Dray, S. M., & Seigel, D. A. (2007). Understanding Users In Context: An In-Depth Introduction to Fieldwork for user-centred Design. Interact 2007, 712- 713.

Edwards, P., Jackson, S., Bowker, G., & Knobel, C. (2007). Understanding infrastructure: dynamics, tensions, and design. NSF Report of a Workshop: History and theory of infrastructure: lessons for new scientific cyberinfrastructures.

Ekman, P. & Erixon, C. (2009). The interconnectedness of 'best practices': how small and midsize companies can gain from selecting the large companies' IT. Proceedings of the 25th IMP Conference, 1–11.

Elgammal, A., Turetken, O., van den Heuvel, W. J., & Papazoglou, M. (2010). On the formal specification of regulatory compliance: a comparative analysis. International Conference on Service-Oriented Computing (pp. 27-38). Springer Berlin Heidelberg.

El Kharbili, M. (2012). Business process regulatory compliance management solution frameworks: a comparative evaluation. In: Ghose A, Ferrarotti F (eds) Proceedings of the 8th Asia-Pacific Conference on Conceptual Modelling (APCCM 2012). ACS, Inc., Melbourne, Australia, pp 23–32

Ernst & Young LLP. (2006). Global Customs Risk Management: An Examination of Leading Practices. https://go.ey.com/33kw6ww

Fleiss, J. (1971). Measuring nominal scale agreement among many raters. Psychological Bulletin, 76(5), 378–382.

Forsgren, M., Holm, U. & Johanson, J. (1995). Division headquarters go abroad – a step in the internationalization of the multinational corporation, Journal of Management Studies 32 (4) 475–491.

Forsgren, M., Holm, U. & Johanson, J. (2005). Managing the Embedded Multinational: A Business Network View, Edward Elgar, Cheltenham.

Garrett, J. J. (2002). The Elements of User Experience: User Centered Design for the Web. New Rides Publishing US.

Gartner's IT Glossary (2019). https://www.gartner.com/en/information-technology/glossary

Gartner (2019). Market Guide for Global Trade Management Software. W. McNeill, O. Sanchez Duran. https://www.gartner.com/doc/reprints?id=1-56URX82&ct=180712&st=sb. Published 10 July 2019 - ID G00366069.

Gattiker, T. & Goodhue, D. (2005). Enterprise system implementation and use at Bryant Manufacturing: an analysis of ERP fits and misfits. Production and Inventory Management Journal, 44(1), 1–9.

Giessmann, A. & Legner, C. (2016). (2016). Designing business models for cloud platforms. Faculty of Business and Economics (HEC), University of Lausanne. Info Systems J (2016) 26, 551–579

Gil-Garcia, J. R., Chengalur-Smith, I., & Duchessi, P. (2007). Collaborative e-Government: impediments and benefits of information-sharing projects in the public sector. European Journal of Information Systems, 16(1), 121–133. doi:10.1057/palgrave. ejis.3000673

Gillai, B. & Vorburger, A.-C. (2007). Business Value of Global Trade Management Solutions. Stanford Graduate School of Business. Global Supply Chain Management Forum

Gong, P., Feng, Z., Jiang, J. & Knuplesch, D. (2017). bpCMon: A Rule-Based Monitoring Framework for Business Processes Compliance. International Journal of Web Services Research

Ghoshal, S. & Bartlett, C. A. (1990). The multinational corporation as an interorganizational network. Academy of Management Review 15 (4) (1990) 603–625.

Governatori, G. (2005). Representing business contracts in RuleML. Int J Coop Inf Syst 14(2–3):181–216

Governatori, G. & Sadiq, S. (2009). The journey to business process compliance. In: Handbook of research on BPM, IGI Global, pp 426–454

Guo, L., Wei, S.Y., Sharma, R. & Ron, K. (2017). Investigating e-business models' value retention for start-ups: the moderating role of venture capital investment intensity. International Journal of Production Economics, Vol. 186, pp. 33-45

Gregor, S., & Jones, D. (2007). The Anatomy of a Design Theory. Journal of the Association for Information Systems, 8(5), 312-335.

Greene M. & Caragher N. (2015). Supply Chain Control Tower: Providing Greater Visibility, Flexibility and Efficiency. "Logistics Viewpoints" 17th September, https://bit.ly/3fuNbJC.

Hanseth, O., & Lyytinen, K. (2010). Design theory for dynamic complexity in information infrastructures: the case of building internet. Journal of Information Technology, vol. 25(1), pp. 1–19, 2010. Available: https://doi.org/10.1057/jit.2009.19

Hanseth, O., Monteiro, E., & Hatling, M. (1996). Developing Information Infrastructure: The Tension between Standardization and Flexibility, Science, Technology, and Human Values, vol. 21(4), pp. 407–426, 1996. Available: https://doi.org/10.1177/016224399602100402

Hashmi, M., Governatori, G., Lam, H.-P. & Wynn, M. T. (2018). Are we done with business process compliance: state of the art and challenges ahead. Springer-Verlag London Ltd., part of Springer Nature, Knowl Inf Syst (2018) 57:79–133 https://doi.org/10.1007/s10115-017-1142-1

Hausman, W., Lee, H. L., Napier, G. R. F., Thompson, A. & Zheng, Y. (2010). A Process Analysis of Global Trade Management - An Inductive Approach. Journal of Supply Chain Management

Henfridsson, O. & Bygstad, B. (2013). The Generative Mechanisms of Digital Infrastructure Evolution. Management Information Systems Quarterly, vol. 37(3), pp. 907–931. Available: https://doi.org/10.25300/MISQ/2013/37.3.11

Henningsson, S. & Hanseth, O. (2011). The essential dynamics of information infrastructures, presented at the International Conference of Information Systems (ICIS), Shanghai, 2011.

Hevner, A. R., March, S. T., Park, J. & Ram, S. (2004). Design science in information systems research. MIS Quarterly Vol. 28 No. 1, pp. 75-105/March 2004

Higginson, J. K., (2013). Cross- border Issues and Research, Handbook of Global Logistics, New York: Springer New York

Holm, U. & Johanson J. (1995). Headquarters' knowledge of subsidiary network contexts in the multinational corporation. International Studies of Management & Organization 25 (1/2) 97–119.

Holsapple, C., Wang, Y. & Wu, J. (2005). Empirically testing user characteristics and fitness factors in enterprise resource planning success. International Journal of Human-Computer Interaction, 19(3), 325–342.

Hong, K. & Kim, Y. (2002). The critical success factors for ERP implementation: an organizational fit perspective. Information and Management, 40(1), 25–40.

In, J., Bradley, R., Bichescu, B. C. & Autry, C. W. (2018). Supply chain information governance: toward a conceptual framework. The International Journal of Logistics Management Vol. 30 No. 2, 2019 pp. 506-526

Jiang, J., Aldewereld, H., Dignum, V., Wang, S. & Baida, Z. (2014). Regulatory compliance of business processes. AI & Soc 2015 30:393–402 DOI 10.1007/s00146-014-0536-9, Springer-Verlag London

Johnson, G., Whittington, R., Scholes, K., Angwin, D., Regnér, P., Steve, P. (2014). Exploring strategy : text & cases. Harlow : Pearson Education Limited, 2014. Tenth edition.

Joshi, R. (2011). Optimizing the Global Trade Management Solution Evaluation, Selection Process. Cognizant 20-20 Insights, https://cogniz.at/2HDIf5P

Kaniadakis, A. (2012). ERP implementation as a broad socio-economic phenomenon. The agora of techno-organisational change. Information Technology & People Vol. 25 No. 3, 2012 pp. 259-280

Kerr, T. (2009). Ramping Up Customs Compliance Reviews. The China Business Review; Washington Vol. 36, Iss. 2, (Mar/Apr 2009): 48-51

Ketokivi, M. & Choi, T. (2014). Renaissance of case research as a scientific method. Journal of Operations Management 32 (2014) 232–240 http://dx.doi.org/10.1016/j.jom.2014.03.004

Kim, J. (2016). The platform business model and business ecosystem: quality management and revenue structures, European Planning Studies, 24:12, 2113-2132, DOI: 10.1080/09654313.2016.1251882

Klappich, C. D. (2005). Gartner Analyzes the Global Trade Management Market for 2006 and Beyond", Gartner Research, 19 December 2005

Klievink, B., Bharosa, N. & Tan Y.-H. (2015). The collaborative realization of public values and business goals: Governance and infrastructure of public-private information platform. Government Information Quarterly 33 (2016) 67–79

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, October-December 2012 DOI: 10.4018/jegr.2012100102

Knill, D. C., & Richards, W. (1996). Perception As Bayesian Inference. Cambridge, USA.

Kotabe, M. & Mudambi, R. (2009). Global sourcing and value creation: Opportunities and challenges. Journal of International Management 15 (2009) 121–125

Krackhardt D. (1990). Assessing the political landscape: structure, cognition, and power in organizations. Administrative Science Quarterly 35 (2) 342–369.

Kubat, R. (2019). Balancing Compliance and Continuous Improvement in Highly Regulated Industries. Quality Magazine

Kumar, S., Kwong, A. & Misra C. (2009) Risk mitigation in offshoring of business operations. Journal of Manufacturing Technology Management Vol. 20 No. 4, 2009 pp. 442-459

Landis, J. & Koch, G. (1977). The measurement of observer agreement for categorical data. Biometrics, 33(1), 159–174.

Lippincott, S. (2019). Control tower technology value matrix 2019. Nucleus Research. Research note program: supply chain management. document number: T 137 September 2019. https://bit.ly/2OyvOMl

Luckham, D., (2002). The power of events: an introduction to complex event processing in distributed enterprise systems. Web. Berlin, Heidelberg: Springer Berlin Heidelberg; 2002. p. 3. doi:10.1007/978-3-540-88808-6_2

Lv, Y., Ni, Y., Zhou, H. & Chen, L. (2016). Multi-level ontology integration model for business collaboration. Int J Adv Manuf Technol 2016 84:445–451 DOI 10.1007/s00170-016-8508-5

Mao, J.-Y., Vredenburg, K., Smith, P. W., & Carey, T. (2005). The State of User Centered Design Practice. Communications of the ACM, 48(3), 105-110

March, S., T. & Smith, G., F. (1995). Design and natural science research on information technology. Decision Support Systems 15 (1995)251-266.

Maurer, C., Berente, N. & Goodhue, D. (2012). Are enterprise system-related misfits always a bad thing? Proceedings of the 45th Annual Hawaii International Conference on System Sciences, 4652–4661

McIntyre, S. R. (2008). Integrated governance, risk and compliance: improve performance and enhance productivity in federal agencies. Technical reports, PricewaterhouseCoopers

Mintzer, S., H., Alexis, M., A., Vander Schueren, P., (2011). The Criminalization of Import Violations by Customs Authorities. Understanding Global Trends in Customs Enforcement. Mayer Brown. https://bit.ly/2HD55KU

Monteiro, E. & Hanseth, O. (1996). Social shaping of information infrastructure: on being specific about the technology. Information technology and changes in organizational work, Springer, Boston, MA, 1996, pp. 325–343. Available: https://doi.org/10.1007/978-0-387-34872-8_20

Moore, J. F. (1996). The death of competition: Leadership and strategy in the age of business ecosystems. New York, NY: HarperCollins.

Muro, M., Liu, S., Whiton, J. & Kulkarni, S. (2017). Digitalization and the American workforce. Full report. Brookings Metropolitan Policy Program

Musik, C. & Bogner, A. (2019). Digitalization & society. A sociology of technology perspective on current trends in data, digital security and the internet. Österreich Z Soziol (2019) (Suppl 1) 44:1–14 https://doi.org/10.1007/s11614-019-00344-5

Olivieri, F. (2014). Compliance by design. Synthesis of business processes by declarative specifications. Ph.D. Thesis, Dipartimento di Informatica, Università digli Studi di Verona, Italy and Institute for Integrated and Intelligent Systems, Griffith University, Australia

Overbeek, S., Klievink, B., Hesketh, D., Heijmann, F., & Tan, Y. H. (2011). A web-based data pipeline for compliance in international trade. Paper presented at the WITNESS Workshop, Delft, The Netherlands.

Reekmans, C. & Simoens G. (2010). How high are the tax compliance costs for Belgian SMEs, Faculty of Economics and Business, Ghent University, Belgium, https://lib.ugent.be/fulltxt/RUG01/001/459/791/RUG01-001459791_2011_0001_AC.pdf

Rong, K., Shi, Y., Shang, T., Chen, Y. & Hao, H. (2017). Organizing business ecosystems in emerging electric vehicle industry: Structure, mechanism, and integrated configuration. Energy Policy 107 (2017) 234–247

Rose, L. (2017). Free Trade Is Not Free: The Costs of Trade Compliance for Businesses. Global Trade and Customs Journal, Volume 12, Issue 1.

Rugman, A.M. & D'Cruz, J.R. (2003). Multinationals as Flagship Firms: Regional Business Networks. Oxford University Press, Oxford.

Rukanova, B., Henningsson, S., Zinner Henriksen, H. & Tan, Y.-H. (2018). Digital Trade Infrastructures: A Framework for Analysis. Complex Systems Informatics and Modeling Quarterly (CSIMQ) eISSN: 2255-9922. Published online by RTU Press, https://csimq-journals.rtu.lv Article 80, Issue 14, March/April 2018, Pages 1–21 https://doi.org/10.7250/csimq.2018-14.01

Sadiq, S., Governatori, G. & Naimiri, K. (2007). Modeling Control Objectives for Business Process Compliance. In Proceedings of the 5th International Conference on Business Process Management, pp.149–164. Brisbane, Australia: Springer-Verlag. 2007

Sambamurthy, V., Bharadwaj, A. & Grover, V. (2003). Shaping Agility Through Digital Options: Reconceptualizing the Role of Information Technology in Contemporary Firms. MIS Quarterly, vol. 27, no. 2, pp. 237-263, Jun. 2003.

Sardar, S. & Lee, Y. M. (2015). Modeling the Impact of Border Crossing Bottlenecks on Supply Chain Disruption Risk. In International Journal of Engineering and Technology Vol. 7 No. 2 Apr-May 201

Satell, G. (2017). Mapping Innovation: A Playbook for Navigating a Disruptive Age. Publisher(s): McGraw-Hill. ISBN: 9781259862243.

Schwab, K. (2016). The Fourth Industrial Revolution, New York: Crown Business, [2016]. ISBN: 9781524758868 1524758868

Simon, H. (1996). The Sciences of the Artificial. Third Edition. Cambridge, MA, USA.

Sinkovics, R. R., Roath, A. S. & Tamer Cavusgil, S. (2011). International Integration and Coordination in MNEs Implications for International Management. Manag Int Rev 2011 51:121–127 DOI 10.1007/s11575-011-0076-1

Świerczek, A. (2014). The impact of supply chain integration on the 'snowball effect' in the transmission of disruptions: An empirical evaluation of the model, International Journal Production Economics, 157, pp. 89-104.

Tallberg, J. (2002). Paths to Compliance: Enforcement, Management, and the European Union. International Organization 56, 3, Summer 2002, pp. 609-643 © 2002 by The IO Foundation and the Massachusetts Institute of Technology

Tan, Y.-H., Björn-Andersen, N., Klein, S., & Rukanova, B. (2011). Accelerating global supply chains with IT-innovation (pp. 157–173). Berlin, Germany: Springer-Verlag. doi:10.1007/978-3-642-15669-4_10

Terry, J. & Standing, C. (2004). The Value of User Participation in E-Commerce Systems Development. Informing Science Journal, Volume 7, 2004 http://www.inform.nu/Articles/Vol7/v7p031-045-216.pdf

Thomas, K. J. (2020). What is a Control Tower? An overview of the fundamental concepts and principles behind enterprise control towers. Worldlocity. https://bit.ly/3fuic0g

Thomson Reuters & KPMG International (2016). Global Trade Management Survey. https://assets.kpmg/content/dam/kpmg/xx/pdf/2016/10/2016-global-trade-management-survey-from-thomson-reuters-and-kpmg-international.pdf

Titze, C. (2020). What supply chain managers should know about control towers. Article published at Supplychaindive Press Releases https://bit.ly/2ZmVoda

Trzuskawska-Grzesińska, A. (2017). Control towers in supply chain management - past and future. Journal of Economics and Management. DOI: 10.22367/jem.2017.27.07

Tu, Z., Zacharewicz, G. & Chen, D. (2014). A federated approach to develop enterprise interoperability. Springer Science Business Media New York

Van Beijsterveld, J. A. A. & van Groenendaal W. J. H. (2015). Solving misfits in ERP implementations by SMEs. 2015 Wiley Publishing Ltd, Information Systems Journal 26, 369–393.

Veenstra, A. W. (2019). International Trade, Global Supply Chains and Compliance, Chapter 7, Operations, Logistics and Supply Chain Management, Springer International Publishing AG, part of Springer Nature 2019.

Voss, C., Tsikriktsis, N., Frohlich, M. (2002), Case research in operations management. London Business School, London, UK. International Journal of Operations & Production Management, Vol. 22 No. 2, 2002, pp. 195-219.

Yamin, M. & Sinkovics, R.R. (2007). ICT and MNE reorganisation: the paradox of control, Critical Perspectives on International Business. 3 (4) 322–336.

WCO (2015). Customs compliance and data quality. Customs Compliance Framework Recommendation on Data Quality. List of acceptable and unacceptable terms in data quality (Item IV. j) on the agenda

WTO (2019). WTO lowers trade forecast as tensions unsettle global economy, PRESS/840 PRESS RELEASE, https://www.wto.org/english/news_e/pres19_e/pr840_e.htm

Wu, W.-P. (2008). Dimensions of social capital and firm competitiveness improvement: the mediating role of information sharing. Journal of Management Studies 45 (1) 122–146.

Yamin, M., & Sinkovics R. R. (2010). ICT deployment and resource-based power in multinational enterprise futures. Futures 42 (2010) 952–959. http://dx.doi.org/10.1016/j.futures.2010.08.027

Zach, O. & Munkvold, B. (2011). ERP system customization in SMEs: a multiple case study. Proceedings of the Pacific Asia Conference on Information Systems, 1–12.

zur Muehlen, M., Indulska, M., Kamp, G. (2007). Business process and business rule modeling languages for compliance management: a representational analysis. In: International conference on con- ceptual modeling, pp 127–132

Further reading

ArchiMate® 3.1 Specification (2019). The Open Group Standard, ISBN: 1-947754-30-0 Document Number: C197 Published by The Open Group, November 2019. https://www.opengroup.org/archimate-forum/archimate-overview

Arcitura Design Patterns (2020). The Arcitura Education Patterns, Mechanisms and Metrics Master Catalog. https://patterns.arcitura.com/

CompaniesandMarkets.com: Global Trade Management Software Market: New industry analysis published. (2014). Weblog post. Newstex Trade & Industry Blogs , Chatham: Newstex. May 8, 2014.

Competing in 2020: winners and losers in the digital economy. (2020). A Harvard Business Review Analytic Services Report, April 25, 2017.

Customs compliance and data quality. Customs Compliance Framework Recommendation on Data Quality List of acceptable and unacceptable terms in data quality. (2015). World Customs Organisation (WCO). Permanent Technical Committee. 207th/208th Sessions - 3 - 6 March 2015.

Data pipeline carrier - Pipeline Data Exchange Structure (PDES). (2020). United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT).

Export Controls. An increasing challenge to comply. (2015). Deloitte Academy, 28 April 2015.

Global Customs Risk Management. An Examination of Leading Practices. (2006). 2006 Symposium Chair Customs & International Trade Practice Ernst & Young LLP.

Multi Modal Transport Reference Data Model. (2018). United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT) - Multi Modal Transport Reference Data Model.

Semantic Web. (2020). World Wide Web Consortium (W3C). https://www.w3.org/standards/semanticweb/

Taking the cloud-first approach. (2018). A special supplement to modern materials handling. Bridget McCrea. August 2018 / modern materials handling mmh.com.

The automation imperative. (2018). Operations. McKinsey&Company.

WCO ISCM Guidelines. (2018). World Customs Organisation. https://bit.ly/321yU2G.

WCO SAFE Package. WCO tools to secure and facilitate global trade. (2018). World Customs Organisation. https://bit.ly/2DF5iPu.

About the author

Vivien MONTI is the founder and co-owner of Vivansa (www.vivansa.com), a private company established in Belgium and specialised in the field of electronic Customs. Vivien is passionate about Computer Science and participated in the major reforms launched by the European Commission (TAXUD) in the field of Customs over the last 20 years. Vivien holds a MSc degree in Engineering and Management of Telecommunications Networks from the Institut Polytechnique de Paris - Telecom SudParis, which he decided to complement with a MSc degree in Customs & Supply Chain Management at the Rotterdam School of Management (RSM) to be best prepared to address the digitalisation challenges ahead in the field of Customs and Global Trade.
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Appendix A – Qualitative Survey conducted at 7 MNEs

Title: Digitalisation of Customs Compliance in the context of Companies operating globally

Date: Monday, February 023, 2020

Q1: Please select the industry sector of your multinational company

Answered: 6 Skipped: 0

ANSWER CHOICES	RESPONSES	
Agriculture; plantations; other rural sectors	0.00%	0
Automotive	33.33%	2
Basic Metal Production	0.00%	0
Chemical industries	33.33%	2
Construction	0.00%	0
Education	0.00%	0
Financial services; professional services	0.00%	0
Food; drink; tobacco	0.00%	0
Forestry; wood; pulp and paper	0.00%	0
Health services	0.00%	0
Hotel; tourism; catering	0.00%	0
Mining (coal; other mining)	0.00%	0
Mechanical and electrical engineering	16.67%	1
Media; culture; graphical	0.00%	0
Oil and gas production; oil refining	0.00%	0
Postal and telecommunications services	0.00%	0
Public services	0.00%	0
Shipping; ports; fisheries; inland waterways	0.00%	0
Textiles; clothing; leather; footwear	0.00%	0
Transport (including civil aviation; railways; road transport)	0.00%	0
Utilities (water; gas; electricity)	0.00%	0
Other (please specify)	16.67%	1
TOTAL		6

Q3: Indicate company (global) annual turnover

Answered: 6 Skipped: 0

ANSWER CHOICES	RESPONSES	
Less than $1B	0.00%	0
Between $1B and $10B	16.67%	1
More than $10b	83.33%	5
TOTAL		6

Q4: Please select the best description of your position

Answered: 6 Skipped: 0

ANSWER CHOICES	RESPONSES	
Manager	83.33%	5
Associate or Analyst	0.00%	0
Director	16.67%	1
C-level executive	0.00%	0
Vice President	0.00%	0
President	0.00%	0
TOTAL		6

Q5: What department do you currently report into?

Answered: 6 Skipped: 0

ANSWER CHOICES	RESPONSES	
Finance	0.00%	0
Logistics	0.00%	0
International Trade and Customs	50.00%	3
Supply Chain	16.67%	1
Tax	33.33%	2
Legal	0.00%	0
Procurement	0.00%	0
Internal compliance	0.00%	0
Other (please specify)	0.00%	0
TOTAL		6

Q7: Which among the items below would you consider as pain point(s) to the optimal execution of the Customs Compliance function in your department / organisation (multiple choice allowed)?

	VERY LOW IMPACT ON OPERATIONS	LOW IMPACT	MEDIUM	HIGH	VERY HIGH IMPACT ON OPERATIONS	TOTAL	WEIGHTED AVERAGE
Insufficient headcount assigned to Customs compliance activities	0.00% 0	16.67% 1	16.67% 1	33.33% 2	33.33% 2	6	3.83
Current IT tooling does not effectively support compliance goals	0.00% 0	0.00% 0	33.33% 2	33.33% 2	33.33% 2	6	4.00
Budgetary constraints on compliance management	0.00% 0	0.00% 0	50.00% 3	33.33% 2	16.67% 1	6	3.67

Lack of desired skills/expertise with import/export compliance functions	0.00% 0	50.00% 3	0.00% 0	50.00% 3	0.00% 0	6	3.00
Insufficient visibility into corporate developments impacting Customs compliance	0.00% 0	0.00% 0	66.67% 4	33.33% 2	0.00% 0	6	3.33
Lack of availability of reliable data (e.g. to fulfil declaration filing process, to do reporting, etc.)	0.00% 0	0.00% 0	16.67% 1	50.00% 3	33.33% 2	6	4.17
Difficulty to adapt to constantly changing rules and regulations	0.00% 0	0.00% 0	66.67% 4	33.33% 2	0.00% 0	6	3.33
Lack of senior management or local management buy-in and support	0.00% 0	33.33% 2	0.00% 0	66.67% 4	0.00% 0	6	3.33
Insufficient internal controls (policies procedures, training, etc.)	0.00% 0	33.33% 2	33.33% 2	33.33% 2	0.00% 0	6	3.00
Lack of awareness and/or inability to influence corporate decisions	0.00% 0	33.33% 2	50.00% 3	16.67% 1	0.00% 0	6	2.83
Not being in control due to many operations being outsourced (e.g. to brokers, 3rd Party Logistics companies, etc.)	0.00% 0	33.33% 2	50.00% 3	16.67% 1	0.00% 0	6	2.83

Q8: Rate the following Customs-related activities in terms of how you perceive the risk for penalties, other government sanctions, or increased import costs. (one choice per row)

Answered: 6 Skipped: 0

	VERY LOW RISK	LOW	MEDIUM	HIGH	VERY HIGH RISK	N/A	TOTAL	WEIGHTED AVERAGE
Import valuation	0.00% 0	0.00% 0	66.67% 4	0.00% 0	33.33% 2	0.00% 0	6	3.67
Product import classification	0.00% 0	16.67% 1	16.67% 1	33.33% 2	33.33% 2	0.00% 0	6	3.83
Inter-company transfer prices	0.00% 0	50.00% 3	33.33% 2	0.00% 0	16.67% 1	0.00% 0	6	2.83
Import documentation and licensing	16.67% 1	16.67% 1	16.67% 1	50.00% 3	0.00% 0	0.00% 0	6	3.00
Export controls (dual use, restricted party screening)	0.00% 0	0.00% 0	66.67% 4	0.00% 0	33.33% 2	0.00% 0	6	3.67
Customs broker management	0.00% 0	33.33% 2	50.00% 3	16.67% 1	0.00% 0	0.00% 0	6	2.83
Free trade agreements	0.00% 0	33.33% 2	16.67% 1	33.33% 2	16.67% 1	0.00% 0	6	3.33
Supply chain security	16.67% 1	50.00% 3	16.67% 1	16.67% 1	0.00% 0	0.00% 0	6	2.33
Global transportation management	0.00% 0	50.00% 3	50.00% 3	0.00% 0	0.00% 0	0.00% 0	6	2.50
Free trade zone	33.33% 2	50.00% 3	16.67% 1	0.00% 0	0.00% 0	0.00% 0	6	1.83
Temporary import	16.67% 1	66.67% 4	16.67% 1	0.00% 0	0.00% 0	0.00% 0	6	2.00

Q9: Is your organisation using a Global Trade Management (GTM) system (such as SAP GTS, Amber Road, Descartes, etc.)?

Answered: 6 Skipped: 0

ANSWER CHOICES	RESPONSES	
Yes, at global level (same GTM system (or group of GTM systems) is used everywhere)	50.00%	3
Yes, at regional level (various GTMs system may coexist on a per region basis, but no real interconnexions between regions)	33.33%	2
Yes, at local / single-country level (high heterogeneity of GTM systems, often working in 'silos')	0.00%	0
No, mainly manual tasks (by the means of xls macros, email communication, etc)	16.67%	1
TOTAL		6

Q10: Does the fact that the GTM system is used at regional / local level create consistency issues? (multiple choice allowed)

Answered: 2 Skipped: 4

ANSWER CHOICES	RESPONSES	
Yes, there are important disparities. Some sites / countries are digitalised, others are not, which overall penalises the whole organisation and does not allow for Customs Compliance to be fully in control	50.00%	1
Yes, there are important disparities, but overall this is not really impacting the organisation as a whole since Customs Compliance is essentially a local matter.	50.00%	1
Yes, the issue is that several GTMs are used within the organisations (e.g as a consequence of merging/acquisitions) and integration issues between those GTMs make it very hard to obtain a global visibility on Customs Compliance processes	0.00%	0
Yes, the issue is that our GTM does not cover all requirements (e.g. does not allow for EU28 connectivity to Customs Authorities) and needs to be complemented by additional functionalities eventually offered by external providers, which overall does not allow for the Customs Compliance processes to be fully in control.	0.00%	0
Other (please specify)	0.00%	0
Total Respondents: 2		

Q11: Which GTM system is used by your organisation? (multiple choice allowed)

Answered: 5 Skipped: 1

ANSWER CHOICES	RESPONSES	
SAP GTS	40.00%	2
Oracle GTM	0.00%	0
Amber Road	20.00%	1
Integration Point	20.00%	1
Livingstone Trade Sphere	0.00%	0
GT Nexus	0.00%	0
TradeBeam	0.00%	0
Descartes	20.00%	1
WiseTech Global	0.00%	0
Internally developed system	0.00%	0
Other (please specify)	60.00%	3
Total Respondents: 5		

Q12: What Customs Compliance activity is your department / organisation managing with its GTM system(s)? (multiple choice allowed)

Answered: 5 Skipped: 1

ANSWER CHOICES	RESPONSES	
HTS Classification Storage	80.00%	4
HTS Classification Determination	40.00%	2
Customs Valuation	40.00%	2
Calculation of Customs Duty, Import VAT, and other taxes	60.00%	3
Documentation generation (pre-filing, filing of transit/import/export declaration)	60.00%	3
FTA Qualification Analysis (origin calculation)	40.00%	2
FTA Certification of Origin Solicitation (Trade Product Certification)	20.00%	1
Bonded Warehouse Management	40.00%	2
Free Trade Zone (FTZ) management	0.00%	0
OPR / IPR related controls	0.00%	0
Export License determination and management	60.00%	3
Supplier Assessment	20.00%	1
Management Reporting (post-filing)	20.00%	1
Data analytics	0.00%	0
Other (please specify)	40.00%	2
Total Respondents: 5		

Q13: Which of the following manual processes is supplemented by the use of spreadsheets, (e.g. xls macros) or other basic data structures or email communications? (multiple answers allowed)

Answered: 1 Skipped: 5

ANSWER CHOICES	RESPONSES	
HTS Classification Storage	100.00%	1
HTS Classification Determination	100.00%	1
Customs Valuation	100.00%	1
Calculation of Customs Duty, Import VAT, and other taxes	100.00%	1
Documentation generation (pre-filing, filing of transit/import/export declaration)	100.00%	1
FTA Qualification Analysis (origin calculation)	100.00%	1
FTA Certification of Origin Solicitation (Trade Product Certification)	100.00%	1
Bonded Warehouse Management	100.00%	1
Free Trade Zone (FTZ) management	100.00%	1
OPR / IPR related controls	0.00%	0
Export License determination and management	100.00%	1
Supplier Assessment	100.00%	1
Management Reporting (post-filing)	100.00%	1
Data analytics	100.00%	1
All of the above	0.00%	0
Other (please specify)	0.00%	0
Total Respondents: 1		

Q14: Would you say that manual processes restrict the speed and accuracy of customs and global trade compliance reporting?

Answered: 1 Skipped: 5

ANSWER CHOICES	RESPONSES	
Yes	100.00%	1
No	0.00%	0
TOTAL		1

Q15: Which among the following items do you think would be required to address the Customs Compliance issues your department / organisation is facing? (one answer per line)

Answered: 6 Skipped: 0

	WON'T HAVE (NOT A PRIORITY FOR THE MOMENT)	COULD HAVE (NICE TO HAVE, BUT SMALL IMPACT IF LEFT OUT)	SHOULD HAVE (IMPORTANT REQUIREMENT THAT IS NOT VITAL, BUT ADDS A SIGNIFICANT VALUE)	MUST HAVE (NON-NEGOTIABLE REQUIREMENTS THAT IS MANDATORY FOR THE CORRECT EXECUTION OF THE FUNCTION)	N/A (ALREADY IN PLACE IN THE ORGANISATION OR OUT OF SCOPE)	TOTAL	WEIGHTED AVERAGE
Better interpretation and communication of Customs Compliance requirements across sites and countries	0.00% 0	16.67% 1	16.67% 1	50.00% 3	16.67% 1	6	3.40
Customs Compliance activities consistently applied across all sites and countries	0.00% 0	0.00% 0	66.67% 4	16.67% 1	16.67% 1	6	3.20
Flexible adaptation to complex and changing requirements of local Customs authorities	16.67% 1	16.67% 1	16.67% 1	50.00% 3	0.00% 0	6	3.00
Customs compliance practitioners effectively assisted by digital tooling (e.g. control tower offering global visibility)	0.00% 0	0.00% 0	16.67% 1	66.67% 4	16.67% 1	6	3.80
All actors of the supply chains (suppliers, carriers, 3PLs) aligned to Customs Compliance objectives and practices	0.00% 0	0.00% 0	50.00% 3	33.33% 2	16.67% 1	6	3.40

All actors of the supply chains (suppliers, carriers, 3PLs) aligned to Customs Compliance objectives and practices	0.00% 0	0.00% 0	50.00% 3	33.33% 2	16.67% 1	6	3.40
Increased visibility on external partners activities (e.g. brokers)	0.00% 0	16.67% 1	33.33% 2	33.33% 2	16.67% 1	6	3.20
Reduction in the number of a external partners (e.g. brokers) and insourcing of the whole Customs Compliance function	0.00% 0	0.00% 0	66.67% 4	33.33% 2	0.00% 0	6	3.33
Reliance of multiple external partners (e.g. brokers, 3PLs) as long as the global visibility on their operation is ensured (e.g. by the mean of a digitalised 'control tower').	0.00% 0	16.67% 1	83.33% 5	0.00% 0	0.00% 0	6	2.83
Better data quality ('making the right data available at the right time to the right people')	0.00% 0	0.00% 0	16.67% 1	83.33% 5	0.00% 0	6	3.83
Record keeping and audit trails (historical transactional data) digitally managed	0.00% 0	0.00% 0	16.67% 1	66.67% 4	16.67% 1	6	3.80
Better organisation of the Customs & Trade Department	0.00% 0	16.67% 1	16.67% 1	50.00% 3	16.67% 1	6	3.40
More headcount dedicated to Customs Compliance tasks	16.67% 1	16.67% 1	16.67% 1	50.00% 3	0.00% 0	6	3.00
Support from external experts / consultants	16.67% 1	16.67% 1	66.67% 4	0.00% 0	0.00% 0	6	2.50
Increased management support	0.00% 0	16.67% 1	16.67% 1	33.33% 2	33.33% 2	6	3.25
Additional training of Customs Compliance practitioners	0.00% 0	16.67% 1	66.67% 4	16.67% 1	0.00% 0	6	3.00

Q16: Overall, how would rate your level of satisfaction with regards to the current level of digitalisation of Customs Compliance processes within your organisation?

Answered: 6 Skipped: 0

	1 - VERY DISSATISFIED	2	3	4	5	6	7	8	9	10 - VERY SATISFIED	TOTAL	WEIGHTED AVERAGE
(no label)	16.67% 1	16.67% 1	0.00% 0	16.67% 1	0.00% 0	33.33% 2	16.67% 1	0.00% 0	0.00% 0	0.00% 0	6	4.33

Appendix B – Representative GTMS vendors

The table below (Table 13) is intended to provide more understanding of the market and its offerings. However, the vendors listed hereafter do not imply an exhaustive list. The vendors are categorised by the major components sold that closely correspond to the area the vendor most addresses or was originally built to address.

Three market segments are considered: **L** = Logistics, **C** = Compliance, **F** = Finance (see table below). This does not mean, however, that, if a segment is not flagged, the vendor has absolutely no functionality to support that area. It just means that area is not something a buyer would necessarily go to that vendor to buy as a stand-alone product.

Table 13: Representatives GTMS vendors (to be updated)

Vendor	Product, Service, or Solution Name	Headquarter	Founded	Markets			Architecture / Technology
				L	C	F	
AEB	ASSIST4, XPRESS, and ATC rebranded to nEXt	DE	1979	X	X		Heavy clients on workstations + server-side system (MS-Windows Server, Oracle database or MS SQL). Server-to-Server interop with AEB data center. Recently (2017) introduced web-based clients. Moving from in-premises to cloud-based.
Bamboo Rose	Product Lifecycle Management (PLM) Global Sourcing Order management	USA	2003	X	X		Digital marketplace meant to connect retailers, suppliers, and manufacturers to collaborate virtually. Works towards becoming 100% SaaS.
Bolero International	Galileo Platform	UK	1998			X	Collaborative platform supporting trade flows between multiple parties. SaaS applications and services focused on Trade finance and maritime expertise. convergence of physical and financial supply chain by incorporating multi-banking capability with eBL (electronic Bills of Lading) flows.
BluJay Solutions	Transportation GTN Compliance GTN	UK	1972	X	X		BluJay's Global Trade Network (GTN) is meant as a 'network of networks' that help customers connect and collaborate across their supply chains. About 50,000 participants worldwide.
CargoSmart	Various			X	X		
Descartes Systems Group	Transportation Management Customs & Regulatory Compliance			X	X		
E2open	Cloud Logistics, INTTRA, Amber Road, Terra Technology			X	X		Meant as a trade automation suite. In the process of consolidating various technologies of recently acquired solutions (e.g. Amber Road) into one single collaborative network (called E2net).
Freightgate	Freightgate Logistics Cloud			X	X		
Foreign-Trade Zone (FTZ)	SmartZone Premier				X		
inet-logistics	inet TMS			X			
Infor	Infor Nexus			X		X	
JDA	JDA TMS			X	X		
Kyriba	Working Capital					X	

Livingston International	TradeSphere		X		
LOG-NET	LOG-NET Platform	X	X		
MercuryGate	MercuryGate TMS	X			
MIC	MIC CSS, MIC-CUST, MIC OCS, MIC ECM		X		
Napier	Napier		X		
OCR Services	EASE		X		
Oracle	Oracle Transportation Management (OTM) Global Trade Management (GTM)	X	X		
Orbian	Orbian technology platform			X	
PrimeRevenue	OpenSCI			X	
QAD Precision	QAD Precision Transportation Execution	X	X		
QuestaWeb	TradeMaster	X	X		
SAP	SAP Transportation Management (TM) SAP Global Trade System (GTS)	X	X		SAP ABAP (proprietary) SAP HANA (proprietary)
Taulia	Working Capital, Invoicing, Intelligent Platform			X	
Thomson Reuters	ONESOURCE		X		
Tradeshift	Tradeshift Pay			X	
Traydstream	Traydstream platform			X	
Tungsten Corp.	Tungsten Network			X	
WiseTech Global	CargoWise One	X	X		

Appendix C – Evaluation of Qomply® Control Tower Prototype

The Qomply® Control Tower Prototype evaluation report is presented below. It aims at asserting whether the implemented prototype covers all the requirements establishing the foundation of the Compliance Control Tower *for* Customs (CCT-C) Design Pattern.

To do so, the evaluation uses a 0-100% completeness rating, where 0% means not implemented and 100% means fully implemented (in conformance with the recommended standards and technologies).

id.	Label	Scope	Completeness
REQ.CCT.00	**The artefact shall primarily be meant as an enabler of Customs compliance practices.**	Qomply	58%
	The digitalisation of Customs compliance in the context of companies operating globally has to be driven by Compliance practices. To provide the necessary control over Compliance operations, the compliance practices enabler shall allow implementing the Customs compliance elementary business functions by the concurrent enablement of business collaborations, compliance tasks (assigned to users or systems), and compliance services (either manual or automatic).		
	REQ.CCT.01 Enable business collaborations	Qomply	60%
	REQ.CCT.02 Enable compliance tasks management	Qomply	47%
	REQ.CCT.03 Enable compliance services	Qomply	45%
	Moreover, to ease the linkage of disparate, geographically dispersed data sources, the platform supporting the instantiation of compliance practices, should preferably:		
	REQ.DP.01 Make use of Cloud Computing (CC) based technology Cloud computing (CC) offers significant advantages particularly for the decentralized and loosely coupled nature of Global Supply Chains (GSC), due to the fact that IT processes are becoming more and more stable and flexible, e.g., through scalability and virtualization.	Froggg's	80%

id.	Label	Scope	Completeness
REQ.CCT.01	**Enable business collaborations**	Qomply	60%
	The collaborations between the parties taking part in the ecosystem can be of various types such as Business-to-Business (B2B), Business-to-Government (B2G), or Government-to-Business (G2B). Collaborations are made of structured contexts for specific interactions. These interactions allow the exchange of master data elements that the involved professionals must understand, recognise, and eventually augment to support their own specific business processes. At business level, business collaboration should be formalized using the concept of tradelane (or equivalent). At platform level, business collaborations should rely on the services concurrently provided by the Digital Platform & Ecosystem (DPE), the social network, and the Semantic Web data network.		
	REQ.CCT.04 Make use of Tradelanes Within an environment where various types of trade transactions are executed in autonomy and interlinked	Qomply	30%

	opportunistically, it is difficult to plan and control compliance measures. Therefore, there is a need for a set of trade transactions to be categorised, codified and formally interlinked in order to control their executions and take the required compliance measures in time. The formalisation as tradelane should help achieve this objective.		
	REQ-DP-02 **Make use of Digital Platform & Ecosystem (DPE)** The DPE is an enabler of the business ecosystem construct through which the Customs compliance function can be implemented through the perspective of an economic community including multiple (internal and external) parties, thus stepping outside the (sometimes narrow) framework of the enterprise.	Froggg's	80%
	REQ-DP-03 **Make use of Social network-like technology** Given the cross-cutting nature of Customs compliance, social interactions have even higher importance. Establishing closer ties between trading parties (i.e. suppliers, transporters, manufacturers, freight forwarders, brokers, etc.) is increasingly cited as a critical differentiator of high and low performers in global supply chains.	Froggg's	50%
	REQ-DP-04 **Make use of Semantic Web data network** Compliance practitioners, whatever the role they have in the Supply Chain, must agree on the nature and the semantics of their business collaborations by the means of a bilateral recognition process (Lv et al., 2016). To do so, they use the Master Data Management (MDM) and SOA Canonical Schema Bus Facilities that the Data Pipeline makes accessible to them. Hence, the following key requirements: **REQ-DP-05** **Master Data Management** **REQ-DP-06** **SOA Canonical Schema Bus**	Froggg's	80%

id.	Label	Scope	Completeness
REQ.CCT.02	**Enable compliance tasks management**	Qomply	47%
	There is a need for (to be executed) compliance business activities (=tasks) to be identified, registered, assigned and executed in a controlled way. This should be the role of a Compliance Task Manager to answer this requirement. To that aim, the Task Manager shall be able to react on business events tracked by Compliance Control Points (CCP) and to trigger the execution of Compliance Measures (CM).		
	REQ.CCT.05 **Compliance Control Point (CCP)** Complex business processes involving multiple business functions of the organisation can lead to a lack of control when they should be associated with compliance activities. Therefore there is a need for business events to be automatically detected across the various organisation's business functions, in such a way they can be associated with pre-defined compliance activities (or measures) following dynamic Complex Event Processing (CEP) rules.	Qomply	40%
	REQ.CCT.06 **Compliance Measure (CM)** Compliance measures that are not well-defined and	Qomply	20%

	assigned to relevant parties at the right time cannot be efficiently executed and controlled. Therefore, there is a need for a set of compliance measures pertaining to a specific ecosystem to be pre-defined and codified as (automated) business processes (or workflows) that trigger the execution of compliance activities assigned to parties according to their capabilities and positioning inside the ecosystem.		
	REQ-DP-07 SOA Orchestration An orchestration platform is dedicated to the effective maintenance and execution of parent business process logic. Modern-day orchestration environments are especially expected to support sophisticated and complex service composition logic that can result in long-running runtime activities.	Froggg's	80%

id.	Label	Scope	Completeness
REQ.CCT.03	**Enable compliance services**	Qomply	45%
	Much of the market is still served by regional players. Complex financial and Customs regulations often require organisations to rely on local solutions that were either built at the same time and along with the regulations or certified by the government to support their processes. Therefore there is a need for the CCT to be able to consume compliances services which could be of various nature (in-house, external) and accessible through various channels (Web service, file drop, EDI, etc.).		
	REQ.CCT.07 Compliance service Compliance capabilities offered by various parties without standardised interfaces are difficult to integrate. Therefore, there is a need for compliance capabilities to be exposed by service providers as services according to standardised service contracts in order to be dynamically consumed through the execution of configurable compliance measures.	Qomply	15%
	REQ-DP-07 SOA Enterprise Service Bus (ESB) An enterprise service bus represents an environment designed to foster sophisticated interconnectivity between services. It establishes an intermediate layer of processing that can help overcome common problems associated with reliability, scalability, and communications disparity.	Froggg's	80%
	REQ-DP-08 SOA Federated Endpoint Layer Federation is an important concept in service-oriented computing. It represents the desired state of the external, consumer-facing perspective of a service inventory, as expressed by the collective contracts of all the inventory services. The more federated and unified this collection of contracts (endpoints) is, the more easily and effectively the services can be repeatedly consumed and leveraged (Tu et al., 2014).	Froggg's	40%

Appendix D – Expert Review of Qomply® Control Tower Specifications

Introduction

This appendix provides the checklist of items being subject to the expert review of the Qomply® Control Tower functional and technical specifications conducted at Company D. For each review item, an indication of whether the review successfully passed (or not) is provided together with a description of how the Qomply® Control Tower addresses the related requirements. Three types of requirements are considered: general requirements, functional requirements, and non-functional requirements.

General Requirements

GR.01	Regain control and optimize export and import customs data	Passed? (Yes / No)
		Yes

'Regain control' is among the Top 3 issues reported by compliance practitioners, who too often are not able to have Customs compliance fully in control due to the compliance operations being diluted inside and outside the organisation. 'Regain control' has therefore been the leit-motive which drove the early stages of the Qomply® Control Tower development.

To address this requirement, the Qomply® Control Tower adopts an architectural vision that has absolutely no comparison on the market and lets users enter into the era of interrelated business ecosystems, complex event processing (CEP) and machine learning.

Functional Requirements

FR.01	Ability to be fed and/or connected to all Company D's brokers	Passed? (Yes / No)
		Yes

With the Qomply® Control Tower, Company D benefits from a very efficient way to connect the often-disparate data sources of external stakeholders (suppliers, brokers, freight forwarders, transporters).

To do so, the Qomply® Control Tower uses the functionality of the relying data pipeline infrastructure (running the Froggg's middleware). Through these integration capabilities, brokers are no longer outside the control of Company D's trade department and Company D recovers full visibility on the trade operations Brokers have been assigned to.

FR.02	Ability to cope with variable IT capabilities of Brokers	Passed? (Yes / No)
		Yes

Being an Original Equipment Manufacturers (EOM), Company D's business ecosystem involves a very high number of external stakeholders (160 brokers operating in 42 countries), thus a very high heterogeneity of the IT environments that Company D has to deal with.

Broker's IT capabilities may vary from one country to another and also depending on the broker size. Some brokers are very small low-tech companies (e.g. working with Excel files), some are medium to large size companies making use of customs-related services offered by local providers (e.g. MIC, AEB, KGH, etc.).

The Qomply® Control Tower integrates this characteristic 'by design' and provides remarkable integration capabilities able to cope with the variety of broker's systems whatever the size or readiness of their IT environment. To do so, the Qomply® Control Tower supports a huge variety of Electronic Data Interchange protocols and formats as summarized below.

Moreover, the Qomply® Control Tower has the possibility to establish 'ad-hoc' data interchanges based on a proprietary (non-standard) protocol should it be required.

The protocols and formats supported by the Qomply® Control Tower are summarized hereafter:

Protocols

- HTTP/HTTPS
- POP3/SMTP
- OFTP/OFTP2
- SOAP
- WebDAV
- X.400
- EDIINT working group:
  - EDIINT AS1 (extension to mail transport)
  - EDIINT AS2 (based on HTTP transport)
  - EDIINT AS3 (based on FTP transport)
  - EDIINT AS4 (based on WebServices)

Formats

- *ANSI X.12*
  - X12
  - X12 Document List
  - X12 EDIFACT Mapping
- *XML*
  - cXML
  - xCBL
  - ebXML
  - railML
  - RosettaNet
  - UBL
  - UNIDOC
- Tradacoms
- EDIFACT
- Cefic – Chemical
- GS1 EANCOM – Retail
- EDIBDB – Construction
- EDIFICE – High Tech Industry
- EDIFURN – Furniture
- EDILEKTRO – Electro
- EDILIBE – Books
- EDITEC – Sanitary
- EDITEX – Fashion
- EDIFOR/EDITRANS – Transports & Logistics
- EDIWHEEL – Wheels & Tires
- ETIS – Telecommunication
- STAR – Standards for Technology in Automotive Retail
- SPEC2000 (Airline Industry) (external link)
- FORTRAS – Transports & Logistics

Fixed-length formats

- EURITMO

Separator formats

- CSV/TSV/DSV

FR.03	Ability to support all languages used by brokers (Chinese, roman, Cyrillic, etc.)	Passed? (Yes / No)
		Yes

The Qomply® Control Tower is meant to work in highly siloed, heterogeneous environments. This implies that the Qomply® Control Tower natively supports a wide variety of character sets as summarised in the table below.

Common character encodings [edit]

- ISO 646
  - ASCII
- EBCDIC
  - CP037
  - CP930
  - CP1047
- ISO 8859:
  - ISO 8859-1 Western Europe
  - ISO 8859-2 Western and Central Europe
  - ISO 8859-3 Western Europe and South European (Turkish, Maltese plus Esperanto)
  - ISO 8859-4 Western Europe and Baltic countries (Lithuania, Estonia, Latvia and Lapp)
  - ISO 8859-5 Cyrillic alphabet
- Mac OS Roman
- KOI8-R, KOI8-U, KOI7
- MIK
- ISCII
- TSCII
- VISCII
- JIS X 0208 is a widely deployed standard for Japanese character encoding that has several encoding forms.
  - Shift JIS (Microsoft Code page 932 is a dialect of Shift_JIS)
  - EUC-JP
  - ISO-2022-JP
- JIS X 0213 is an extended version of JIS X 0208.
  - Shift_JIS-2004
  - EUC-JIS-2004

- ISO 8859-6 Arabic
- ISO 8859-7 Greek
- ISO 8859-8 Hebrew
- ISO 8859-9 Western Europe with amended Turkish character set
- ISO 8859-10 Western Europe with rationalised character set for Nordic languages, including complete Icelandic set
- ISO 8859-11 Thai
- ISO 8859-13 Baltic languages plus Polish
- ISO 8859-14 Celtic languages (Irish Gaelic, Scottish, Welsh)
- ISO 8859-15 Added the Euro sign and other rationalisations to ISO 8859-1
- ISO 8859-16 Central, Eastern and Southern European languages (Albanian, Bosnian, Croatian, Hungarian, Polish, Romanian, Serbian and Slovenian, but also French, German, Italian and Irish Gaelic)

- CP437, CP720, CP737, CP850, CP852, CP855, CP857, CP858, CP860, CP861, CP862, CP863, CP865, CP866, CP869, CP872
- MS-Windows character sets:
  - Windows-1250 for Central European languages that use Latin script, (Polish, Czech, Slovak, Hungarian, Slovene, Serbian, Croatian, Bosnian, Romanian and Albanian)
  - Windows-1251 for Cyrillic alphabets
  - Windows-1252 for Western languages
  - Windows-1253 for Greek
  - Windows-1254 for Turkish
  - Windows-1255 for Hebrew
  - Windows-1256 for Arabic
  - Windows-1257 for Baltic languages
  - Windows-1258 for Vietnamese
  - ISO-2022-JP-2004
- Chinese Guobiao
  - GB 2312
  - GBK (Microsoft Code page 936)
  - GB 18030
- Taiwan Big5 (a more famous variant is Microsoft Code page 950)
  - Hong Kong HKSCS
- Korean
  - KS X 1001 is a Korean double-byte character encoding standard
  - EUC-KR
  - ISO-2022-KR
- Unicode (and subsets thereof, such as the 16-bit 'Basic Multilingual Plane')
  - UTF-8
  - UTF-16
  - UTF-32
- ANSEL or ISO/IEC 6937

FR.04	Ability to connect other Global Trade Management Software (GMTS) already in use with Company D	Passed? (Yes / No)
		Yes

Similarly as for external stakeholders (cf. FR.02), the Qomply® Control Tower offers integration capabilities to connect existing GMTS (e.g. E2OPEN) and/or ERP (e.g. SAP). This way, the Qomply® Control Tower also offers the possibility to be fed by Company D's master data (for example those required at pre-filing time) and automate a number of compliance tasks. This is precisely the ability of the Qomply® Control Tower to be fed by/get access to ERP/GTMS data on the one side and to be fed by/get access to brokers data on the other side, that allows the Qomply® Control Tower to be used as an intermediate decision-support component which allows Customs compliance practitioners to organize their daily activity and access a wide range of Customs-related services.

FR.05	Ability to generate automatic tasks and alerts	Passed? (Yes / No)
		Yes

The Qomply® Control Tower is meant as a decision support tool which implements Complex Event Processing (CEP) to capture Master Data that is relevant from a Customs compliance perspective and autonomously turns those data into Customs Compliance Measures (CCM). Similarly as an air traffic control, the Qomply® Control Tower monitors the manufacturing process execution and identifies exceptions, bottlenecks, and compliance risks to be addressed at the right time. The Qomply® Control Tower supports all stages of the Customs Compliance value journey, providing end-to-end visibility, alerts, decision-support, and intelligent agents. The end-to-end visibility means access to all compliance information bits across the chain on a real-time basis. This capability unlocks a huge potential of error detection during the preparation of compliance-related data (e.g. pre-filing of Customs declaration) as well as enhanced process automation.

Moreover, decision analytics allow organisations to convert data into meaningful business insights and decisions (e.g. decision not to process a declaration if a wrong HS code pattern was detected for a specific movement).

At post-filing time, the Qomply® Control Tower helps diagnose pain points and/or detect errors by capturing volumes of data and analysing them in parallel to normal Customs compliance operations. Among the various functionality offered, it is worthwhile to mention:

- Ability to raise alerts when a discrepancy or anomaly are detected;
- Ability to notify concerned parties (e.g. brokers and/or Company D users) through email so that corrective measures can be taken;
- Registration and follow-up of the corrective measures;
- Quick and easy access to relevant declarations for which an anomaly was detected.

FR.06	Provide duty savings dashboard facilities	Passed? (Yes / No)
		Yes

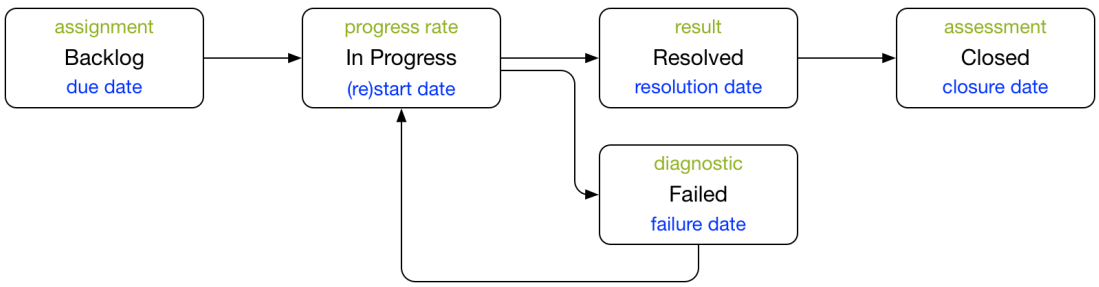
The Qomply® Control Tower provides authorised users with access to a customisable Customs Compliance Dashboards (CCD). Among the various items that the users can monitor, the CCD a specific focus is put on duty saving optimization. Duty savings are considered both at pre-filing time and post-filing time. At pre-filing time, the Qomply® Control Tower allows users to be alerted for potential savings (for example, to recommend the usage of an existing FTA based on the knowledge of the exporting country, and/or the importing country, and/or the HS code, and/or the origin of the good, etc.). At post-filing time, the Qomply® Control Tower allows for calculating the amount of potential FTA savings based on specific criteria (e.g. per region, country, company, etc.). It also allows for consolidating all amounts of duty paid (DD + ADD / CVD / section 301, etc.).

FR.07	The flow of alerts, answers, modification, etc. must be archived and made accessible	Passed? (Yes / No)
		Yes

The Qomply® Control Tower applies Complex Event Processing (CEP) patterns which are orchestrated by means of a central component called Compliance Task Manager (CTM). The CTM triggers, tracks and traces the Customs Compliance Measures (i.e. CCM) that have to be executed by the relevant actors depending on their specific business roles.

Each business event (alerts, answers, modifications, etc.) triggering the execution of a Customs Compliance Control Point (CCCP) is subject to a new item (= task) in the Customs Compliance Backlog (CCB). The item is assigned to a designated user according to its defined role(s). Each measure triggered by a CCCP is also subject to a (sub) CCB item.

All CCB items are driven by a state-transition-flow depicted below.



The application offers a Graphical User Interface (GUI), providing users with a set of features to visualize and control the progress of CCB items.

As far as automated CCMs are concerned, the related IT service contract and endpoint (i.e. service provider) are specified to support the automatic Customs Compliance Service (CCS) invocation (e.g. perform duty calculation, perform declaration filing, etc.).

When a CCM is relating to a "manual" activity assigned to a user, the collaborative features of the Qomply® Control Tower can be used to realize the required interactions between concerned people or by triggering automated CCM manually (when the input of the related CCS cannot be produced automatically).

The result, diagnostic (in case of exception) and assessment of the executed measures are also recorded through the related CCB item, being available for further analysis and reporting through the Customs Compliance Dashboard (CCD).

FR.08	Ability to set KPIs, to search for KPIs, to display KPIs	Passed? (Yes / No)
		Yes

The Customs Compliance Dashboard (CCD) made accessible to authorised users allows the setting-up and monitoring of KPIs. The dashboard allows virtually any kind of KPI to be set, including those referred to in the brief document provided by Company D:

Number of import (be able to provide the number by broker)	√
Number of export (be able to provide the number by broker)	√
Export: Countries where exported	√
Import: Countries where imported + name of supplier	√
Number of export with certificate of origin	√
Customs value imported (CIF Value or FOB Value - depending on the country) Customs Value on Export (statistic value in EU)	√
Transport mode (air, sea, road...)	√
Point of exit / entry (port / airport)	√
Number of brokers used	√
Origin of goods	√
HS codes exported and imported	√
Description of goods	√
Incoterms used	√
Regime used	√
Part numbers (CAI, ML, AT, ...)	√
ECS Status	√
EU only: risk on VAT – proof of exit	√
Delay for clearance	√
Number of controls by the customs administration	√

Non-Functional Requirements

NFR.01	Ability of the Control Tower to be adaptable and extensible (for business needs and technology evolution)	Passed? (Yes / No)
		Yes

The Qomply® Control Tower is meant 'by design' to scale both in capacity and in geographical coverage. The Qomply® Control Tower architecture enables to repeatedly apply a cost-effective strategy for extending the system capacity e.g. to cover the needs of another department, another country, or another region.

The intelligent data synchronisation between Qomply towers allows building composite towers providing a higher level of visibility (e.g. EMEA-level visibility based on the composition of EU-based + South-Africa-based towers). This is particularly useful to cover the needs of multinationals, which are structurally organised as a concatenation of multiple ecosystems interacting with each other.

NFR.02	The access to the Control Tower must be secure	Passed? (Yes / No)
		Yes

The security of the Qomply® Control Tower is enforced at different levels, including:

- Deployment Container level, according to the hosting party's security policies.
- Communication Protocols level, through firewalls and HTTP/S Reverse Proxy.
- Functional Interfaces level, protecting accesses to API and Service Endpoints using the Qomply Identity Provider.
- Data Stores level, protecting accesses to data through the Security Guard of the Data Services architecture.

In addition to the technical measures, the persons entrusted to operate/maintain the Qomply® Control Tower must sign a non-disclosure agreement and each access to the infrastructure is recorded in a secure audit log.

Intrusion & Vulnerability Detection. As the first line of defence, the security architecture includes:

- Firewall provided by Cloudflare, an enterprise-class Web Application Firewall (WAF) that protects from common vulnerabilities such as SQL injection attacks, cross-site scripting, and cross-site forgery requests with no changes to the addressed infrastructure.
- Reverse Proxy that shields GUI and API from the external world and by only allowing a given set of URI.
- Container Vulnerability Detection provided by CoreOS Clair, enabling a more transparent view of the security of container-based infrastructure.

Access Controls

Identity Management

All users accessing the Qomply® Control Tower must be duly identified with the support of the Qomply® Identity Provider. When a customer subscribes to the Qomply® services, he receives credentials relating to the administrative responsibilities inside his new account. He can then invite new users to participate in the Qomply® registration process. The administrator can subsequently assign roles and permissions to them, providing authorizations or not to access features and datasets. No bulk load or download of identities, roles or permissions are authorized. Note that the Qomply® registration process does not require any sensitive Personally Identifiable Information (PII). Only information about the business of his organization is proposed to be specified, without specific obligation.

Authentication

Users are identified through a username (i.e. email address)/password mechanism supported by the Qomply® Identity Provider (with configurable password policies), that produces a temporary token (as per the Oauth2 Authentication specifications) supporting authentication and Single Sign-On (SSO) across the platform. As far as XML-based web services are concerned, it is possible to integrate SAML 2.0 through the same mechanism.

Authorization

API, Service Endpoints and Datasets are protected against illegitimate usages. Authorizations to access applications and data are based on the so-called Roles Based Access Control (RBAC) principles. The way roles and permissions are defined and assigned is under the responsibility of the Qomply® account administrator (initially defined at subscription time), as well as under the responsibility of the owners of specific elements inside business collaborations. In Qomply®, a business collaboration, as a context, is similar to a closed group of users that access a specific set of services and data for specific purposes (typically business interactions). Each group is managed in isolation although the same user can participate in multiple collaborations. Coarse-grained permissions can therefore be granted at the collaboration level according to defined roles, and fine-grained permissions can be granted at the level of service capabilities (including data services) and data elements as required by the context.

Audit Trail

Access to services and data is logged, not only for functional purposes but also for security reasons. Activities of users are recorded in order to provide traceability of data provenance and usage (in some cases according to data protection requirements). Related logging data is recorded in specific datasets (in which only the system is able to write) that can be subject to consultations like other types of datasets by authorized users (typically administrators).

Data Protection

Controlled Data Management

The access to data and integrity of data are protected across the Master Data Management process that incorporates security considerations at the levels of:

- Acquisition Points that log the provenance of data, ensure its validity and get consent from the person whose data is being collected. Consent makes reference to regulations that apply to the organization using the Qomply® Platform in question and the data it collects. It is enforced and recorded when business collaborations are established.
- Reference Point that safely stores validated data inside dedicated data stores behind Qomply® Data Services Interfaces ensuring data safeguarding. Data is maintained at the reference point level as long as it is required for consumption by registered consumption points. Archiving and retention of data are applicable according to configurable rules.
- Consumption Points that control access to data through sophisticated measures and logging.

Segregation of Data Stores

Qomply® data stores are dedicated to each customer who subscribed to the service. Data from different customers are never physically mixed. Datastores are maintained through RDF datasets that are physically implemented in different files maintained in separated deployment containers and file systems.

Confidentiality of Data Exchanges

All data exchanges occur through HTTP/S based transmissions. This means that encryption is applied only at the transport layer level. The default web server security configuration applies the following specification:

- Key: RSA 4096 bits (e 65537).
- Weak key (Debian): no.
- Issuer: Let's Encrypt Authority X3.AIA: http://cert.int-x3.letsencrypt.org/
- Signature algorithm: SHA256withRSA
- Extended Validation: no.
- Certificate Transparency: Yes (certificate).
- OCSP Must Staple: no.
- Revocation information: OCSP: http://ocsp.int-x3.letsencrypt.org

The supported protocols are TLS 1.2, TLS 1.1 and TLS 1.0, with a large set of cypher suites.

Data Retention

Data is maintained in the on-line data stores, by default, as far as required by the related business collaborations and business services. Archiving is performed on-demand according to configurations as well as according to requirements of registered data consumers. Archives are produced using the same techniques applied for backups. This includes the ability for authorized users (typically Qomply® account administrators) to download the related files and use them with another RDF-based database engine (knowing that Jena Fuseki used by Qomply® is an open-source implementation freely available). This means also that Qomply® customers are able to get a copy of their data stores (including all archived data) at any time, including after the termination of the service agreement

during a one-month period. After that (or before on request duly verified), their data stores are physically destroyed.

Data Backup

Datastores are backed up under the form of compressed N-Quads files stored in physically and geographically separated locations. Full backups are done on live databases on a daily basis. They take a consistent view of the data and do not include any updates committed after the backup starts. Backups can be called on live databases and read and write transactions continue to be serviced. The transactions that occur through service interfaces between the backups and any incident are stored on a separate file system so that they can be replayed after a backup has been restored.

Because data stores are at the heart of the Qomply® platform functionality, the backup facilities provide a key part of the disaster recovery procedures

NFR.03	IT servers hosting the Control Tower should not be located in the USA or subjected to the US regulations such as the US Nexus	Passed? (Yes / No)
		Yes

The Qomply® Control Tower makes use of the Cloud infrastructure provided the company [Web Hoster],

Through its hosted server policy, [Web Hoster] guarantees that the data stored by the Qomply® Control Tower are physically located on the French territory. Actually, the choice of the physical location of the data is made by the subscriber at the time it purchases the [Web Hoster] service and Vivansa made the choice of the data centre located in Seclin, in the Lille Metropole subarea).

[Web Hoster] also commits to implementing a number of security measures related to the General Data Protection Regulation (RGPD)[34].

NFR.04	If use of collaborative platform, connections should be free of charge	Passed? (Yes / No)
		Yes

The full potential of Qomply® Control Tower relies on its ability to federate (rather than to concentrate) all actors of the supply chain around key partnerships. Partnership means that participating actors in Customs Compliance have a joint value creation effort as a general goal. The goal may or may not be ultimately achieved. The defining attribute of partners is that they are actors on whose participation the value proposition depends, regardless of whether or not they have a direct link to the focal firm (in this case, Company D). Therefore, for the Qomply® Control Tower approach to succeed, it is obvious that any paid membership imposed on external stakeholders would become a major obstacle to the realisation Control Tower value proposition. For this reason, access to the Qomply® Control Tower is free of charge to all external stakeholders participating in Company D's ecosystem.

[34] Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation) - https://eur-lex.europa.eu/eli/reg/2016/679/oj

End of document.