Strategies for Orchestrating and Managing Supply Chains in Public Service Networks

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Abstract: Joining-up is high on the e-government agenda as this is expected to improve service delivery to citizens and businesses. It requires public and private organizations to cooperate with each other within networks that are formed around public services that cross the boundaries of organizations. Cross-organizational processes in such a network are called supply chains, aimed at delivering integrated services. The performance of each individual organization within the network influences aspects such as lead-time and quality of services delivered. In order to effectively integrate the efforts of the various organizations involved, a strategy needs to be in place to orchestrate and manage a service delivery chain. Various types of strategies can be employed. Yet little knowledge is available about which strategies are effective under which circumstances. In this paper we identify four different strategies for managing and orchestrating cross-organizational service chains. These supply chain management (SCM) strategies are based on literature research and case study analysis. The four strategies are identified based on two dimensions: the level of control (i.e. governance structure) and the architectural approach for systems integration. These four strategies are: merger, orchestra, relay race, and broadcasting. For three of the four strategies, illustrative cases have been found. The strategy selection depends on factors such as the institutional environment, political ambitions and organizational readiness. Furthermore, each strategy has its own merits and demerits. We recommend investigating the relationship between situational characteristics and SCM strategies in further research.

Keywords: e-government, joined-up government, Supply Chain Management (SCM), inter-organizational collaboration, governance, integration strategy

1. Introduction

Public service delivery crosses organizational borders. From a citizen's perspective, a single service involves multiple steps to be taken, and these steps are often performed by multiple organizations. Currently, many of the activities required for integrating the various steps into a service are performed by citizens themselves. Government organizations want to relieve citizens of this burden by integrating their service delivery. Integrated service delivery (ISD) is realized when multiple government organizations perform a specific service in a coherent manner and it is perceived as integrated by customers. This has the advantage for customers that they no longer have to provide the same information to several organizations, which diminishes their administrative burden. To realize ISD, government organizations increasingly join-up through the formation of portals in which several organizations offer their services in an integrated manner, or through the formation of networks and chains, in which several organizations cooperate to deliver integrated services that cross organizational boundaries. "*Joined-up government* refers to consistency between the organizational arrangements of programs, polices, or agencies, which may enable them to collaborate" (6 2004, p. 106).

Realizing joining-up of service delivery requires coordination to ensure the quality of services when different steps that make up services are performed by different organizations. "The coordination of the dependencies of the various organizations involved in a service delivery chain in order to perform better service delivery to customers" is called *orchestration* (Janssen, Gortmaker and Wagenaar 2006). Coordination of a chain can take place in a central or a decentralized manner (Hodgkinson 1996; Janssen 2004). Central control emphasizes optimization of the business process, but it also means that the autonomy of organizations is often sacrificed, whereas decentralized control fosters autonomy at the expense of efficiency. At the same time, e-government needs business processes that can be continuously optimized and expanded outside their own organization. While linking information systems to these processes requires enterprise application integration (EAI) technologies, EAI has been an expensive and often problematic solution for many organizations (Linthicum 1999). These problems are multiplied in the public sector, where inefficient and bureaucratic business processes and disparate legacy information systems need to be integrated in an e-government

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environment (Weerakkody, Baire and Choudrie 2006). Therefore, modularization of information systems is often considered to offer the necessary integration options for future expansion of business processes as well as the flexibility that is needed for maintenance (Baldwin and Clark 2000).

However, limited research is available for governments that are in search for a strategy for coordinating their service delivery chains. In this paper, we investigate strategies for managing and orchestrating cross-organizational service delivery. These strategies are categorized according to two dimensions: the level of control and the integration of information systems. First, the dimensions for categorizing the strategies are derived from literature and combined to form a framework for mapping case studies. Then, in order to understand which strategies are being explored, a number of case studies of cross-organizational chains from the Netherlands are looked at and mapped according to these dimensions. Finally, we draw conclusions and identify areas for further research.

2. Theoretical background

Joining-up of service delivery requires organizations to cooperate across organizational borders as information and systems are dispersed. The dependencies between organizations realizing ISD resemble a network structure, in which a multitude of interdependent actors exist (e.g. De Bruijn and Ten Heuvelhof 2000). Realizing ISD, therefore, presents a major challenge for government organizations. It requires that organizations adapt their business processes to the service delivery chain, but often the organizational goals of these autonomous parties are not in line with the goals of the chain as a whole. However, the performance of the chain depends on the individual organizations as their performance impacts quality and lead-time of services. The division of the business process into tasks distributed over many organizations, thus, creates a need for the coordination of these tasks and the information exchanged between the organizations involved.

Supply chain management (SCM) is a term used in business literature to refer to the control of materials, information, and finances as they move in a process from supplier to manufacturer to wholesaler to retailer to consumer (e.g. Romme and Hoekstra 1992). The term supply chain is inspired by the product flow that should be delivered to citizens or businesses by passes through several organizations. SCM encompasses the planning and management of all activities involved the creation of supply chains. Although traditional focused on physical goods, SCM can also be applied in the field of public administration, in which the flow is mainly information-based. It is, therefore, similar to the concept of orchestration found in literature on e-government.

Orchestration realizes ISD by taking over the role from the client of having to integrate the various parts performed by different organizations into a coherent service (Janssen et al. 2006). Instead, it requires government organizations to achieve interoperability of information systems and organizational activities. Joining-up is, thus, a technological challenge as well as a managerial challenge (Klievink and Janssen 2009). On the organizational level, this requires the parties involved to cooperate, share resources, and agree on the responsibilities for the activities performed by the supply chain. On the technology level this requires that the systems of the parties involved are connected and integrated using EAI and that the exchanged information is semantically interoperable. To achieve these objectives, the orchestration and management of the supply chain is necessary.

The control of supply chains always represents a trade-off between central and decentralized control (e.g. Hodgkinson 1996; Janssen 2004). A central control focus emphasizes optimization of the service delivery process, but it requires sacrificing organizational autonomy. Furthermore, although operational costs are low, set-up and standardization costs are often high as a central coordination mechanism requires organizations to agree on and to invest in certain technologies. In a decentralized structure, organizations are more flexible with regard to necessary changes, as they have complete knowledge and control over the allocation of resources to support business priorities, and the costs are fully allocated to the local organizations (Hodgkinson 1996). The chain as a whole, however, will have higher total procurement and operations costs due to inefficiencies related to the duplication of services and of multiple independent procurement procedures and suppliers. In general, centralized coordination enhances optimization of the supply chain and decentralized coordination is more flexible (White, Daniel and Mohdzain 2005).

On the technical level, coordination requires the integration of the various activities using EAI technologies. This requires investments in information and communication technology and leads to significant changes in the mechanisms used to manage the interactions that take place within and

between organizations. Clemons and Row (1992) argue that the ability to coordinate the movement of information is of key importance to both external and internal coordination. Due to changing circumstances coordination and supporting technology can change over time. New laws and regulations might require certain parts of the supply chain to be carried out differently or the participation of new organizations in the supply chain. To ensure sustainability of the supply chain design, adaptability should be realized, e.g. by maintaining a risk profile that can be updated when regulation changes (Van Veenstra and Janssen Forthcoming).

Adaptability can be defined as the ability to deal with new environmental conditions (Gosain, Malhotra and Sawy 2005). It can be improved using modularization (White et al. 2005). *Modularization* means that the different activities that make up a supply chain are each performed by different organizational entities, instead of forming one single integrated process. In general, modularization serves three purposes: it makes complexity manageable, it enables parallel work and improvement and it is tolerant of uncertainty (Baldwin and Clark 2000). In a situation where different organizations perform different parts of the service, SCM focuses on the integration of these modular components. The integration of these modules can take place in a loosely or tightly coupled manner (Papazoglou 2003).

Coupling refers to the degree that the modules depend and rely on each other. *Loosely coupled* means that the modules are independent of each other and one module presents minimal requirements to other modules. This enables easy substitution and replacement of one module for another. Furthermore, input/output relations often have no direct dependency, resulting in the possibility for asynchronous communication, which overcomes the dependency in time (the need for availability). Also, minimal requirements on the data format and the number of interactions necessary to interact with other modules are a result of loose coupling. The advantage of loose coupling is, thus, that a change in one module does not (or hardly) affect the interactions with other modules, whereas *tight coupling* has the possibility of real-time processing and comprehensive data exchange. Other advantages of tight coupling are that at each moment in time the status is known and interventions can be made.

3. Strategies for supply chain management

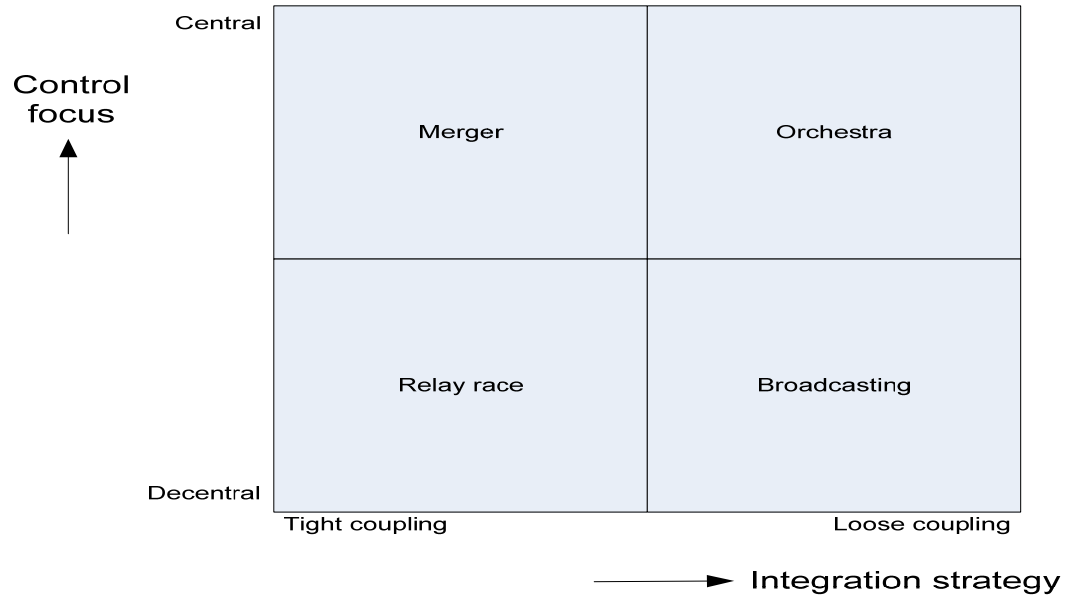

Figure 1: Overview of the four SCM strategies

In the previous section, two main dimensions of SCM strategies were identified from literature: the level of control of the supply chain and the architectural approach for information systems integration. The former dimension refers to a situation with either centralized governance, in which the process of the supply chain is governed hierarchically by an orchestrator, or decentralized governance, in which the supply chain is coordinated on a peer-to-peer basis. The second dimension refers to the way in which the information systems are integrated. This can take place through tight coupling, in which systems are integrated, or loose coupling, in which systems and organizations retain autonomy over the activities that are carried out. Tightly coupled systems are closely connected to each other and

tracking and tracing information is exchanged to keep track of the progress. Whereas in a loosely coupled manner of integrating systems, only primary information is exchanged and tracking and tracing requires a separate service process. Combining these two dimensions, a framework encompassing four SCM strategies can be set up (see figure 1). It should be noted that the two dimensions are not completely unrelated and that this orthogonal representation is a choice for clarity and convenience.

The first strategy is called *merger*. This strategy coordinates the supply chain hierarchically and the information systems are tightly coupled. This results in a supply chain supported by integrated systems that are efficient and that allow for process optimization. Every time a service step is performed and passed on to the next step, a response will be sent from the system receiving the service request to the central node, enabling close monitoring of the process. Organizations involved in the supply chain have little autonomy; hence the metaphor of a merger is used. Because of the central control focus and the highly integrated systems, it is difficult for new organizations to enter the service delivery process unless they also adopt the technology of the chain. As seamless integration takes place, operation costs of the supply chain are low.

The second strategy *orchestra* combines central control over the supply chain with loose coupling of the information systems. The process consists of autonomous entities that perform one step of the service delivery process, but at the same time, the supply chain is managed centrally. This is similar to the way an orchestra functions: while the conductor directs the musicians, they all play their instruments in their specialized manner. Within a supply chain this means that although organizations can perform their part of the service process in a relatively autonomous manner, at the same information has to be exchanged in such a way to allow the process to appear integrated. Therefore, tasks performed by individual organizations have to be interpreted by the orchestrator requiring standardization of outcomes. The information that is exchanged is generally 'thick' allowing for process information to be exchanged alongside information about the service request.

Relay race, the third strategy, on the other hand, refers to a situation in which the process is not managed centrally by the orchestrator, but the supply chain uses information systems that are tightly coupled. This means that the information systems used by the parties involved in this chain exchange predefined messages within closely integrated systems. These messages are 'thin' because they have been previously standardized; the outcome of one step can be interpreted directly by the next system. Central control is thereby replaced by a situation in which the system pushes information to the next party that will then perform its own task, comparable to the exchanges taking place in a relay race. As there is no central mechanism to ensure, for instance, that lead-times do not exceed the maximum duration set by law, this requires that the parties have service level agreements in place that define the role of each of the organizations involved. Costs of setting up this strategy are high and it usually takes a long time before such a supply chain is operational.

In the fourth strategy, *broadcasting,* there is no central control over the supply chain and information systems are loosely coupled, ensuring a flexible process in which parties can easily be replaced by other entities. In this case, all parties within the supply chain enjoy a relatively high degree of autonomy. In order to assess the status of a service (tracking and tracing), a separate request needs to be done, to which only the organization(s) presently working on a request will give a response. In case a request is broadcasted, the supply chain is flooded with a separate notification and only the relevant parties will reply. The trade-off for allowing for a high degree of autonomy for organizations is that there is likely to be a high level of redundancy within the supply chain.

4. Case studies

In order to understand which of these strategies are present within the public domain in the Netherlands, we present three case studies. We were not able to find a case study fitting the *merger* strategy, as this type of central control and tight coupling is not realistic in a situation of an organizational network. In such a network organizations are (semi-)autonomous, operated independently, and there is no overarching hierarchical structure or organization that guides the network. Literature (e.g. Chisholm 1989) confirms that this type of arrangement is not feasible for public sector arrangements. It is often found in situations where private organizations merge their businesses and subsequently integrate their information systems.

4.1 Asbestos removal

The *orchestra* strategy was found in the case of the removal of asbestos. In this case study seven organizations that are involved in the process of asbestos removal have built a centrally positioned information system to decrease the average lead-time of the process. The process covered by this information system starts with filing an asbestos find and ends when the asbestos is removed successfully. Information about each asbestos removal permission request is stored centrally in this system, thereby ensuring that all organizations involved have the same information about a particular discovery of asbestos. At the same time, this system functions as a workflow application by indicating to the client and to all the parties involved in the service delivery chain which steps have been fulfilled and which should be carried out next. This has led to a decrease of the lead-time from six weeks to one week. Control is, thus, organized centrally by the information system.

At the same time, however, the information systems are loosely coupled. All the internal information systems can be connected to the orchestrator, but they do not affect the way in which the individual parties involved carry out their specific task. For instance, the organization that is responsible for the removal of the asbestos can use the information that is stored centrally by logging into the system. They can even reuse the information that they need to carry out their task, such as the address where the asbestos was found, but they do not need to build a new information system based on the requirements of the supply chain. This has led to a higher quality of the service performed by the whole chain. Standardization of tasks has, thus, not only led to a decrease of the administrative burden for the client by not having to provide certain information to each party separately, but it has also increased the performance of the service delivery chain.

4.2 Social security chain

The *relay race* strategy can be found in the case of social security (SUWI) Chain (www.bkwi.nl). This supply chain is structured based on a number of predefined agreements regarding the message structures and the technical implementation (in XML), the use of databases to avoid duplication and overlap among data registers. This supply chain is supported by a system called *Suwinet* that supports the necessary information exchange for achieving cross-organizational processes. This network is formed by the social security agency (UWV), employment and income office (CWI) and municipalities. Both UWV and CWI have a central office that maintains technology and takes care of policy-making. The local offices ensure close collaboration with customers. Although the autonomy of the organizations is retained, there is a central organization that facilitates and monitors the exchange of information within the supply chain. The information exchange processes have been detailed in a mandatory architecture, which has evolved over a very long time. This architecture contains business process rules that prescribe which organization should receive or send information in a particular situation. Furthermore, service levels that are applicable to these interactions have also been defined.

The standardization of processes and information exchange and data formats has resulted in limited adaptability. The presence of a central organization and the description of the current coordination processes and dependencies suggests that analysis of the impact of changes on the organizations, their business processes and applications might easily be carried out. Based on this data, a blueprint and change strategy is thought to be easily developed to optimize the overall supply chain. In reality, the situation is completely different. The creation of the current interoperable architecture took many years and a long negotiation process took place among the independent public organizations. Furthermore, any changes in the organizational network require the involvement of multiple organizations, which might resist change and the division of the costs of the changes over the organizations is a major issue. In the past, the latter has been solved by providing funding by the Ministry of Social affairs for making the necessary changes. Despite this, the large changes necessary require the re-negotiation of data formats and process interactions, which is a long-lasting and cumbersome process.

4.3 System of information exchange between vital registries

An example of the *broadcasting* strategy can be found in the information system supporting the vital registry for citizens in the Netherlands (GBA-V system; www.mGBA.nl). This system, which is currently being implemented, supports information requests from third parties to the vital registries at the municipalities. In the case of a change taking place in one of the vital registries, for instance, if someone moves to a different address, this change of address is passed on to all organizations that

have taken out a subscription to this registry. The municipalities will notify a data warehouse that currently stored information should be updated and third parties that have a subscription to this system, can, in turn, request the updated information.

The events are not passed on directly to all organizations having an interest in them, but instead a data warehouse has been installed. In some cases, this leads to a suboptimal situation, when this information is not passed on to the data warehouse directly, resulting in third parties requesting outdated information. This system relieves municipalities of their current task of having to inform all organizations with an interest in citizens' information about changes that have occurred; supporting information exchange by a service bus to the data warehouse instead. Although the functionality of this system is rather simple and organizations can easily join the supply chain, it takes a long time before all organizations take part, simply because many organizations are involved. Furthermore, the establishment of a unique number for information exchange was crucial. In this case, a unique citizen's number (BSN) was introduced, which was an important enabling factor.

5. Discussion

For three of the four strategies, cases could be found in the Netherlands. These strategies have specific merits and demerits (see table 1). Therefore, we argue that all supply chains should choose a strategy based on their specific requirements. Although we cannot yet draw any definite conclusions because of the limited number of case studies carried out, some first observations can be made regarding which chain characteristics are likely to lead to the choice for one of the strategies.

Table 1: Cross-case study comparison

Case	**Asbestos removal**	**Social security chain**	**Information exchange vital registries**
Strategy	*Orchestra*	*Relay race*	*Event notification*
Characteristics	Orchestrator facilitates information exchange Parties involved retain their own information systems and processes	Supporting organizations facilitate information exchange Evolved over a long time Negotiation of data standards	A data warehouse duplicates all information A service bus facilitates all information exchange between parties involved Implemented in several steps One-way information exchange only
Benefits	Parties can perform their task in an optimal way Lead-time is diminished by higher information quality Overview of the chain process Adaptable; new organizations can join easily and changes of law are supported	Overview of end-to-end supply chain Clear pre-defined processes Service level agreements and clear performance expectations	Source information is being accessed and reused Peer-to-peer links have been replaced by information exchange through a service bus Source information can be checked and updated Adaptable; organizations can join easily
Disadvantages	No clear ownership of orchestrator No control over quality of the tasks of individual organizations Information is duplicated in some cases by organizations to and from the orchestrator	Chain responsibility is unclear No optimization of the internal processes within organizations Low adaptability, long-lasting change processes Changes often require change of technology Bureaucratic, low level of collaboration Limited/no knowledge transfer among organizations	Maintaining information requires a strict protocol for updating and checking information as information can vary across organizations

Based on the characteristics, benefits and disadvantages summarized in table 1, some first factors can be observed to be influential in choosing a SCM strategy for joining-up. Firstly, this table shows

that the institutional context of the network of organizations involved in the chain was influential. Institutional factors such as the availability of resources heavily determine the willingness of organizations to cooperate. Furthermore, it is not surprising that no example of the *merger* strategy could be found as public organizations are highly autonomous within the Dutch government. When joining-up, a network of interdependent departments and organizations emerges (Chrisholm 1989; Powell 1990; De Bruijn and Ten Heuvelhof, 2000). Organizations, however, are not willing to give up their autonomy often resulting in a choice for a modular information systems integration strategy with loose coupling of systems. Also the stability of the supply chain processes was observed to be influential in choosing a strategy. When a supply chain is believed to be stable, organizations may not see the need for adaptive processes and they may feel that establishing a tightly integrated information system with low operational costs is worth a long negotiation process.

Other factors that were observed to be influential are the political ambitions regarding a specific service delivery chain and organizational readiness. When a certain topic becomes important for political reasons, control was observed to be organized in a centralized manner in order to be able to track the decisions and actions performed by different organizations within a supply chain. In politically sensitive supply chains, the possibility of easily tracking and tracing individual cases and the importance of being able to appoint responsibilities is considered more important than being able to achieve adaptability or retaining autonomy for individual organizations. The organizational readiness of the parties involved in the service delivery chain is also observed to be influential, as is demonstrated in the case of the supporting system for the vital registries. In this case, many municipalities were found not to be ready for implementation of the system. Therefore, a loose coupling was foreseen that allows organizations to join a supply chain when they are ready.

First observations, thus, show that institutional context, political ambitions and organizational readiness are among the factors influential in choosing a SCM strategy for managing and orchestrating cross-organizational services. In the context of these factors, a full integration of services may not be feasible, and joining-up may need to focus more on establishing consistency and enabling collaboration (6 2004). The observations made in this paper cannot be generalized as the number of cases is limited. We believe that further research on the factors influencing the choice for a cross-organizational governance strategy would be beneficial for government organizations in search for such a strategy.

6. Conclusions

This paper has identified SCM strategies for joining-up government organizations involved in cross-organizational service delivery chains based on two dimensions: the level of control of the supply chain and the information systems integration strategy. The former dimension refers to a situation in which the supply chain is governed hierarchically by an orchestrator or to a situation in which the supply chain is coordinated on a peer-to-peer basis. The latter dimension refers to tight coupling (i.e. integration) or loose coupling, in which modules are set up independent of each other, of information systems. Based on these two dimensions, we identified four strategies: merger, orchestra, relay race, and broadcasting. Each of those strategies represents another manner of joining-up in order to integrate service delivery. In the Netherlands, we found three of these strategies to be present; the fourth strategy – merger – is, considering the autonomy of Dutch government agencies, unlikely to be found in practice. Organizations need to consider their specific situation and choose a strategy based on their needs. Based on the three cases presented in this paper, we observed that the choice for a specific strategy is made depending on factors such as the institutional context, political ambitions for the service delivery chain and organizational readiness. We recommend that further research should be done on these strategies in cross-organizational public chains in order to create better understanding for government organizations about which strategies might be effective in which circumstances.

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