

# A Collaboration Service Model for a Global Port Cluster

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**Abstract:** *The importance of port clusters to a global city may be viewed from a number of perspectives. The development of port clusters and economies of agglomeration and their contribution to a regional economy is underpinned by information and physical infrastructure that facilitates collaboration between business entities within the cluster. The maturity of technologies providing portals, web and middleware services provides an opportunity to push the boundaries of contemporary service reference models and service catalogues to what the authors propose to be “collaboration services”. Servicing port clusters, portal engineers of the future must consider collaboration services to benefit a region. Particularly, service orchestration through a “public user portal” must gain better utilisation of publically owned infrastructure, to share knowledge and collaborate among organisations through information systems.*

**Keywords:** *Business Architecture, Enterprise Architectures, Port Clusters*

## 1. Introduction

A “global city” is one where money, workers, information and commodities flow thereby linking economic relations between surrounding regions and the global economy there is general consensus that this involves the city’s liveability characteristics as well as its global performance attributes. A key component of the global city is its physical trade link to international trade via its trade gateway (which includes its seaport, airport or inland port). With the presence of customs, the gateway port has an important role in facilitating connectivity and access to international markets.

In seeking to identify the unique characteristics or specific attributes a city must possess to be recognised as a global city, more recent views place far less emphasis on the city’s particular status, role and functions and far greater emphasis on their networks in which key ports are nodes. This is a conceptual paper that proposes a collaboration service model that builds upon the arguments of Robinson (2002) that the port must go beyond being “territorially embedded” in supply chains where third party logistical service providers generate, share and compete with other players in a supply chain. It is for this reason that the authors have focused this discussion on the importance of port community systems.

While the port, as a nodal entry-exit point, represents a fundamental component of infrastructure and asset of a “global city”, this status is also achieved by a vibrant business services sector and industry that has the capability of servicing international economies. The strong links between the port and its city is said to have cemented the success of Valencia’s port cluster for example.

Extending from the international gateway port is its port cluster, made up of firms relying in the transfer of goods their onward distribution. In the cluster the major freight generators and receivers, industrial areas and distribution centres depend on their close proximity to the port; it also includes supply chain activities as well as processing firms and administrative bodies. A cluster also requires advanced professional activity of all kinds; information gathering and diffusion, knowledge and creativity resulting in the production of new services and commodities, the production of which feeds directly into trade within the city/region as well as globally.

Porter (2000) describes clusters as geographic concentrations of interconnected companies, specialised suppliers, service providers and associated institutions in a particular field. Clusters grow at locations where enough resources and competencies amass and reach a critical threshold, giving it a key position in a given economic branch of activity. Several “layers” exist within a cluster and there are freight generators who will benefit most from immediate co-location with a port and other services that require virtual connectivity. Agglomeration economies describe the economic benefits to be derived from co-location of interdependent organisations to common infrastructures (such as utilities or transport) that make the labour and market available.

In an age of advanced telecommunications, contact intensity and business may not be dependant upon physical proximity of people and firms and virtual connectivity can be achieved without geographic proximity (Nijkamp, 2008). Therefore, the success of the global port cluster depends on a model of collaboration to underpin the business architecture and the ICT system.

There is a further factor; climate change is a vital issue for many communities. The impacts of climate change must be addressed at regional and local levels, since local attributes significantly determine the extent of the opportunities and nature of community responses. The expansion of rail and road capacity cannot be sustained indefinitely and focus on more efficient use of the infrastructure should be part of the adaptation process through collaboration within the cluster.

Contemporary portal based systems use Service Reference models to expose the services of individual companies. This paper presents the need to extend the boundaries of existing Service Catalogues by the development of a taxonomy of collaboration services in the development of a port cluster portal.

## 2. Port Community Portals and Trade Management Systems

Contemporary port community systems focus on the day-to-day management of terminals and automate the export and import compliance processes; these support the export process processes by managing export licenses, sending electronic communications to customs and driving outbound trade finance services such as letters of credit etc. Port community systems generally provide a common portal relating to container and export booking status information. Trucking companies and customs brokers check cargo status at a terminal and pay fees online.

There are several examples of port community systems; in Singapore, Portnet® was the ePortal with shipping lines, shipping, customs and government all connected for trade. In Melbourne, Australia, there are on-going pilot studies involving the Port of Melbourne Corporation and a functional definition of an Overarching ICT Platform for the Port of Melbourne supply chain may be found in Red Wahoo (2004). The Port of Los Angeles operates its portal which includes a complete tariff outlining charges, rates and rules for doing business with the port. The Port Authority of New York and New Jersey's e-commerce system provides real-time information on ship arrivals, the status of cargo at marine terminals and traffic. Malaysian Ports were connected in September 2006 to provide a standardised electronic document manifest scheme. The Indian Port Association has established a centralised Port Community System covering all its major ports, as a part of its collective, collaborative and co-operative approach to EDI implementation.

Extending beyond a port community system is a *Trade Management System* and Singapore was widely seen as a leader in "Paperless Trading" (The ICT Working Group, 2002). TradeXchange®, which represents the next phase of Tradenet. TradeXchange® will be the platform for integrated workflows and submissions to seaports, airports, maritime authorities, customs and controlling agencies, which is expected to serve 90,000 registered traders in Singapore.

### 2.1. Enabling Technologies for a Port Cluster System

In this section, we provide an overview of the mature technology fields potentially relevant to developing information infrastructure for a port cluster.

The ICT and business architectures for a port cluster may be drawn from examples of e-Government and e-Commerce. E-Government is a way for governments to use the new technologies to provide people with more convenient access to government information and services (Stiglitz, et al., 2000 and Kung et al., 2007). Ho (2007) describes the development of information technology (IT) and electronic government (e-Government) projects of the Hong Kong Special Administrative Region Government.

Using case studies in three European countries, Weerakkody et al. (2007) explored process and systems integration challenges in the European public sector in the context of e-government implementation. Stojanovic et al. (2004) describe the use of semantic technologies for describing E-Government services to improve the management of changes.

The Business Process Interoperability Framework (BPIF) provides a guide and tools to assist agencies in making the transition to connected and shared modes of operation (AGIMO 2007). Under the Victorian Government's Smart Freight initiative (Bovis Lend Lease, 2004), the Electronic Documentation and Information Transfer Pilot aims to simplify and accelerate information flows between supply chain parties and government.

Technology applications in the supply chain include for example, the analysis of simulated impact of the radio frequency identification (RFID) on inventory replenishment (Wang et al. 2008). Ngai et al. (2008) reviewed the implications of RFID on technological issues, applications areas, policy and security. The flow of information between parties in a supply chain is crucial for carrying out an effective and efficient transition of consignments (Stefansson 2002). The work of Nurmilaakso (2007) found that a larger company or a company with higher skills or having more e-business functions is more likely to replace EDI-based with XML-based e-business frameworks in supply chain integration. Gunaskaran and Nath (1997) discuss the role of information technology in business process reengineering and in terms of collaboration. Wu and Cheng (2008) show that inventory level and cost of the distributor and manufacturer decrease with increased information sharing. Using a multi-case study among SMEs, Welker et al. (2008) showed that simple business conditions are associated with limited information sharing and some use of standard ICT applications.

The implementation of large scale ICT systems has relied on maturity in other areas such as enterprise architectures (EA). As a "virtual network" and the fields of enterprise architecture (EA) will play a role in the planning for a port cluster. Enterprise modelling delivers the blueprints for organisations and their information systems (Jorgenson, 1992, Schekkerman, 2004). Examples of EA

are The Open Group Architecture Framework (TOGAF, 2007), Department of Defence Architecture Framework (DoDAF, 2007), Australian Government Architecture (AGIMO, 2007) and the Zachman Framework (O'Rourke et al. 2003). In a virtual network independent companies are working together based on shared values and a common goal of doing business to jointly exploit a particular business opportunity (Manthou et al. 2004). In terms of federated business models, Yusufa et al. (1999) outlined three levels of cooperation among enterprises culminating in virtual partnership. The work of Tuma (1998) set out to establish a distinct form of network organisation in combination with a high degree of organizational flexibility to provide a “best of everything organisation” by a combination of centres of competence. In a networked cluster, companies must realize that increased accessibility, and productivity, carries a hidden cost of making the data more vulnerable to security breaches (Goes and Chen 2008).

An exceeding useful concept was also discussed about the future actual hosting of the proposed portal. (Hassall, Welsh 2007). Significant financial saving will eventuate if the portal's base platform is not a new platform construct but an existing e-marketplace. This concept although not new is rarely used. An e-marketplace already has a transaction based environment which is also the requirement for the Common User Port Portal. Further to this an e-marketplace can not only host the Portal applications but also many other software applications that can be useful to the Port community users.

The preceding review of the literature shows that the technology fields (e-government, e-business, EA, web services etc.) are capable of supporting a large scale system that supports collaborative business architecture in a port cluster community. However, this requires a collaborative service structure that extends beyond existing service catalogues, which tend to be parochial.

### 3. A Trade Management Portal for a Port Cluster

A trade management system provides a unified platform that ideally offers a one-stop electronic window for the port cluster to view enterprise information, collaborate and conduct business more effectively. Figure 1 shows a context diagram of an “ideal” common user port community portal. For the purpose of comparison, Figure 1 highlights the scope of the majority of traditional port community systems. The portal must achieve the enterprise integration for multiple players in the port cluster, thereby increasing the business value for all the players.

To pursue the concept of a “common user” portal for a port cluster, it must serve a higher purpose beyond a port community system, i.e. at this point, the government may impose performance measures that serve a regional purpose, e.g. reduce overall carbon footprint or maximise the efficiency of the freight distribution network. This requires a new model that promotes collaboration as a

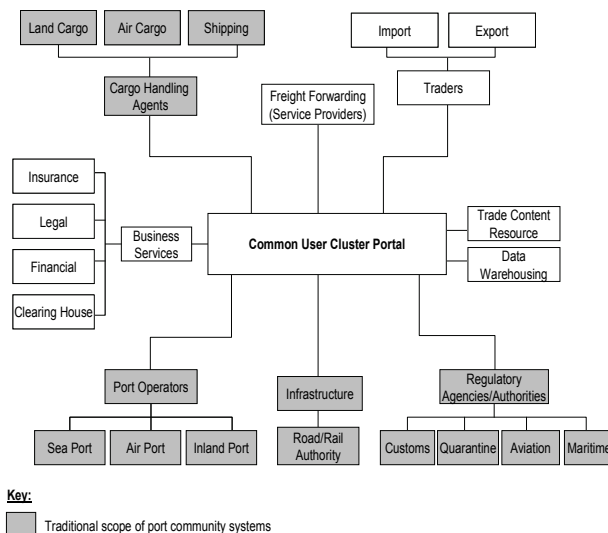


Fig. 1. Context diagram of a portal cluster system

service to achieve efficiencies at a cluster or even a regional level, e.g. reduce overall carbon footprint or maximise the efficiency of the freight network.

The Singapore example is one which carries greater scope and TradeXchange®, which represents the next phase of their development of TradeNet®, will be the platform for integrated workflows and submissions to seaports, airports, maritime authorities, customs and controlling agencies in Singapore. Going beyond its port system, Singapore's Tradenet® has been developed as a nationwide electronic trade network that integrates import, export and transshipment documentation processing procedures.

For any trade management system, the “back end” system that supports the execution of the business processes must be flexible to support change or re-configuration of the business processes to provide new services. For such a system, it is best to leverage an existing Internet backbone to create seamless integration (Hassall, Welsh 2007). This must address disparate legacy systems in use by the port community to orchestrate all the activities in and around the ports and beyond. As an example, the Victorian State Government, in Australia, is investigating the development of a common user portal that will host a broader set of ICT applications for the wider freight and logistics industry. Examples of existing applications include on-line booking, vehicle routing and scheduling, electronic purchasing, web-based inventory management, accounting and on-line auctions, and Intelligent Transport System (ITS) applications. As Figure 1 shows, in addition to the freight generators will benefit most from immediate co-location with a port and other services (such as financial, insurance and legal service providers) that require virtual connectivity should be included as part of the cluster community.

The ICT system which supports the execution and presentation of the service becomes subservient to the business architecture and the development of a “Collaborative Service Model” is now discussed in the following section.

#### 4. Proposal for a Collaboration Service Model

The previous sections of this paper have identified areas of technology areas that are mature; firstly, portal platforms that are capable of dynamic service alignment that preserve the business processes which are private to individual businesses, and exposing only public messages between stakeholders.

Secondly, traditional service catalogue which is a menu of IT services, describing features, components and charges, and provides details of Service Level Agreements (SLAs). For example, the AGA Reference Models (AGIMO, 2007a) provide the basis of a common language between agencies and contain a repository of architectural artefacts (including standards, guidelines, designs and solutions) that may be utilised by agencies to deliver an increasing range of whole-of-government" services.

A "traditional" service catalogue is based on enterprise services of one company. The service catalogue for the port cluster must represent not only the services "exposed" by individual participating companies, but also represents services that encapsulate interactions between companies. The business architecture in a port cluster has to contain a collaborative service catalogue to increase businesses synergies. Collaborative services must be created and orchestrated to make the most of the community's investment in physical and social infrastructure. The aspect of public ownership has a strategic objective to provide greater opportunities for integrating land use and transport, i.e. making efficient use of key corridors for physical movement of freight.

Agglomeration economies may describe the basis for historical growth of industry and the urban environment, but to rely solely on economic forces is insufficient and proactive development of a collaboration model would promote service alignment between industry partners for greater efficiencies. Clusters with a variety of mixed uses at a regional level offer a strong basis for economic growth thus creating opportunities for the more efficient and balanced concentration of services as illustrated by Figure 1. In relation to this, a common user cluster portal is a component of the public infrastructure and must contribute to the wider community.

"Service Orchestration" is a dynamic alignment of several services to achieve new functionality. Service orchestration is conceptually similar to business process orchestration in service oriented architecture (SOA). This requires a registry service capable of managing the list of published collaborative services, which allows the searching and location of collaboration capabilities. More importantly, this involves the definition and registration of collaboration service interfaces. This will also have to involve the registry and management of collaboration patterns. This assists any new stakeholder company that wants to enter the cluster to access the knowledge base of collaboration patterns to promote re-use and better information sharing. The end result is a new composite service that provides a distinct business capability and

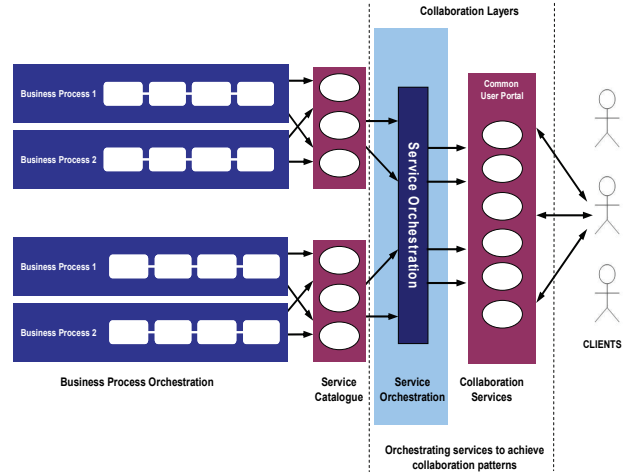


Fig. 2. "Service Orchestration" – Developing Collaboration Services

can be invoked independently. Through this common user portal engine, the atomic business services do not call each other. The architecture for service orchestration (as illustrated in Figure 2) is to combine several services together through a series of logical steps and expose new capability to the consumers.

This distinguishes the common user portal engine because the collaboration services are designed for benefits to a cluster, i.e. measurable via regional performance indicators.

Figure 3 below illustrates a hierarchy of collaboration services emerging from the framework shown previously. One of the ideas to have been put forward in developing the hierarchy is that of "Regulation" as a type of collaboration between private sector and government agencies. Traditionally, one of the difficulties faced by regulation is the asymmetry between the government and the operator with respect to objectives and information. In a regulated environment, various stakeholders invariably hold different levels of information, for example, relating to costs, revenues and order demand. However, of relevance to constrained capacity, infrastructure providers may need to establish rules and incentive mechanisms to alter the demand pattern, e.g. delivery times.

Reducing the information asymmetries through service collaboration and hence the transaction costs that increase

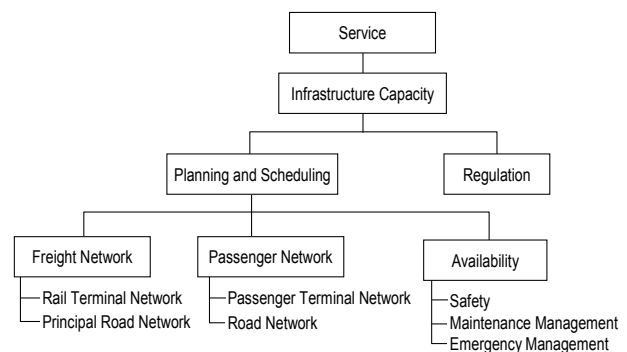


Fig. 3. Hierarchy of collaboration services focused on infrastructure utilisation

infrastructure efficiency is made possible through the concept of a layer of collaboration orchestration.

The argument for this approach is that the infrastructure capacity can rapidly become a limiting factor in providing adequate level of service for the handling of the freight transport task. Deficiencies impact on the reliability and cost of supply chains and also conflicts with the needs of domestic passenger travel, e.g. road and rail congestion. A collaborative model in the use of these facilities (roads and rail networks, ports, intermodal terminals) will maintain transport arteries that are, as far as possible, free of delays and impact to urban amenity.

#### 4.1. Collaboration Objectives and KPIs

A portal that is based on collaborative services must contribute not only to the immediate business community, but in terms of the wider region and must have benefits towards environmental sustainability. Software applications that also have significant business impacts, but are not part of the Port Community portal, can generate significant benefits. Such applications are vehicle routing and scheduling systems, and consignment track and trace systems, to name just two non portal based services. This direction was embraced by the recent Victorian Department of Transport's 'Freight Futures' strategy. (DoT Vic, 2008).

Identifying potential impacts is an important part of the development of collaborative services and the application of measures to a cluster should promote a negotiation of better freight movement schedules etc. These are high-level criteria which for the purpose of the common user portal, must be further developed into performance indicators (PIs) and key performance indicators (KPI), e.g. measuring environmental impact.

This may have an influence in the planning for natural resource management, through this common user collaborative service, which requires an understanding of the social and economic consequences of proposed management actions. Flow-on effects are sometimes the most severe impacts experienced by a community or region. For example, the 'impact' of may be the creation of jobs. The 'flow-on effects' may be the requirement for schools and the demand for community services as the population base increases. In the long term, this builds community resilience and cohesiveness. These effects may not be measurable but they are significant and the likelihood of these should be identified.

## 5. Discussions

A review of e-business models, port community systems has revealed that these are largely transaction based, e.g. e-filing of import notices and payments, etc. The adoption of portal technology in a port cluster promotes greater integration of supply chain partners.

The survey of port community systems has identified a proposal for a "public user portal" by the Victorian Government of Australia. Managed as part of a freight

network, this design perspective has the potential to create a clear direction for all port stakeholders, instilling a code of ethics, a culture of collaboration, and a governance structure for the port stakeholders.

Integrating the management of freight infrastructure with domestic travel modes through a port cluster portal is a concept that can be managed through a technology solution. A collaborative services model that is focused on orchestrating services around infrastructure capacity and availability goes beyond parochial individual business processes. The end result is a reduction in information asymmetries that may increase the reliability of the supply chain and reduce transaction costs through integration with infrastructure management.

It is necessary to consider whether the backbone for a port community system is already available. This includes the technical interfaces between financial clearing houses, enterprise resource planning (ERP) systems and government agencies (involving passport transactions). As an example, the UK Post Office supports a network of fully equipped Post Office® vans and unique mobile counters and trolley-based terminals to ensure customers can still be part of the community. A satellite connection also ensures that customers in even the most remote of places can be served. With this consideration, the robust and scalable infrastructure, which is required for a port cluster system, might already be established.

## 6. Conclusions

A port community "common user" portal engine must serve a higher purpose beyond a trade management system. This requires the collaboration service model that is proposed in this paper to achieve efficiencies at a cluster or even a regional level. A service collaboration model that that improves infrastructure efficiency is an opportunity made possible through the concept of a layer of orchestration that goes beyond current service catalogues.

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