# Coordination as a Service to Enable Agile Business Networks

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**Abstract.** This paper surveys the current organizational requirements of agile business networks and then studies how emerging ICT are addressing the needs. The paper concludes that while several requirements are covered by novel cloud and Saas offerings, several requirements related to service coordination, collaboration, risk management and relation management are not properly addressed by ICT offerings yet. The paper proposes coordination as a service (CAAS) to fill this gap and outlines the key characteristics of CAAS.

**Keywords:** Agile business network**,** Agile Supply chain, Software as a Service, Cloud Computing, Global Coordination, Micro Sourcing, Coordination as a Service.

## 1 Introduction

In today's uncertain global environment business agility is needed that extends beyond organizational boundaries. Networks in which businesses operate also need to be agile. An agile business network is able to respond to largely unpredictable changes rapidly with ease [1]. This requires both the organizations in the network and their horizontal and vertical connections to their business partners to be highly adaptable.

While agile business networks have been described in several conceptual studies, the lack of suitable ICT support has been a key hindrance to their success in practice. Traditional ICT support for connecting the nodes in business networks has been limited to (often cumbersome) static horizontal and vertical integration of enterprise systems. The IT links established are usually limited to coordination and control at the operational level in the context of fixed collaboration patterns.

Over the last few years, several promising technologies have emerged that may enable micro sourcing of services to create agile business networks. Service Oriented Architectures (SOA) have started to open up previously unreachable functionality of

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legacy systems within the enterprise. SOA allows enterprises to renew their ICT infrastructure and applications into a more open, adaptable and scalable architecture. Moreover, the emerging stack of cloud technologies (Infrastructure as a Service IAAS, Platform as a Service PAAS, and Software as a Service SAAS) allows enterprises to radically or gradually adopt a flexible service sourcing model. Services required by the business are acquired based on a pay-per-use rental model. Through flexible contracts services may be sourced quickly and swopped dynamically.

As these developments are maturing, one could assume that the road is now paved for business networks to use these technologies to apply agile practices such as micro-sourcing services on a global scale. However, large scale successful examples are scarce. It appears that more is needed than the rich set of technologies currently available on the market. In this paper we propose that an additional concept; Coordination as a Service (CAAS); is needed to allow business networks to make use of these opportunities. CAAS providers have to do more than just integrating and coordinating internal and external services. They should encapsulate both organizational and technical complexity of service sourcing and integration. In this paper we will explain the need for CAAS and define CAAS and its various aspects. The paper is structured as follows: We first survey the key organizational and technological developments that. Next, we explain the need for CAAS and define important CAAS characteristics. We conclude by presenting conclusions and future research.

## 2 Towards Agile Business Networks

### 2.1 Agile Business Networks

More than a decade ago, Abbe Mowshowitz [2] noted that both organizations and technology are moving towards virtual models. He also stressed that these trends are interconnected. Virtual organization is a concept that applies to technological infrastructures as well as businesses. Mowshowitz describes virtual organization as "as a set of principles for metamanaging goal-oriented activity based on a categorical split between task requirements and their satisfiers". Requests from customers to an organization will usually vary greatly over time. Similarly, due to e.g. market conditions, the set of available services dynamically changes. As a result "the process of assigning services to requests must itself be dynamic". In a virtual organization, a management process is needed that effectively finds and matches services (both technological and organizational) to meet the requirements of the request. This finding and matching process is inherently dynamic and iterative. Based on requirements such as availability of the resource, price, speed or other quality attributes a flexible set of services is contracted. Interestingly, Mowshowitz [2] refers to this type of 'metamanagement' as the successor to traditional outsourcing.

Switching and combining services to fulfill requests is a core part of achieving flexibility. Effective management of this finding, matching and switching process requires clear service requirements, clear management goals and obviously clearly specified resource services. These can be available within the organization or external to the organization. In the latter case contracting the service is required. Such invocation of an external service can be viewed as a form of dynamic sourcing.

These ideas are in line with the concept of business network agility. The need for such agility was first recognized in manufacturing networks: ‘‘Agility is the successful exploration of competitive bases (speed, flexibility, innovation pro-activity, quality, and profitability) through the integration of reconfigurable resources, and best practices in a knowledge-rich environment to provide customer-driven products and services in a fast-changing market environment [3]”.

Similarly, agility of business networks is recognized as a necessity to thrive competitive in global markets. Agile business networks are driven by customer demand and routinely have access to a worldwide production system to deliver customer configured products and services [4]. In general, inter-organizational relationships require careful governance. A comprehensive set of joint processes and practices is needed to achieve a successful sourcing relationship (for an overview see e.g. [5]). We focus here on capabilities that are key to achieving agility. Several key capabilities of agile business networks have been described in literature:

*Modularization of Services, Product, Process* – Products and Services offered and the business processes supporting these have a modular structure. Such a modular structure enables effective sourcing [6]. Quality of the modules can be precisely specified and assessed. Pricing schemes allow for price comparisons [7].

*Coordination and Collaboration Capability* - These are clearly key in agile business networks. As defined by Thomson [8], coordination comprises the protocols, tasks and decision-making mechanisms designed to achieve concerted actions between interdependent units. As outlined by Dekker [9], both formal and informal control mechanisms can be applied to coordinate the inter-organizational relationship (see Table 1).

*Quick Connect Capability* - support integration and quick-connect and quick-disconnect capabilities to external partners. These include searching, contracting, monitoring and enacting services. Such capabilities are needed from the business contract level to the technical infrastructure level [4][10][11];

*Relationship Management Capability*– In agile networks, there is little time to build subjective loyalty between network partners. Therefore, according to Mowshowitz [2] there is only room for “objective loyalty that is based on reasoned self-interest”. Trust cannot be based on long term relationships and past performance either. Therefore agile business networks need to find alternative mechanisms to ensure trust and loyalty. Aziz et al. [12] point out that capabilities such as high quality and formal communications between partners, adaptation of processes, and conflict resolution to higher performance in an inter-organisational relationship.

*Risk Management Capability*– The dynamically formed reciprocal relationships in agile business networks often do not have a stable history. Both at an organizational and technical level building networked relationships are high risk activities [13]. At both technical and organizational levels semantic misunderstandings easily occur. The lack of high quality semantic standards in many industries increases this risk [14].

**Table 1.** Formal and informal control mechanisms, source [9]

| *Outcome control* | *Behavior control* | *Social control* |
|---|---|---|
| *Ex-ante mechanisms* | | |
| Goal setting:<br>Incentive systems/reward structures | Structural specifications<br>-Planning<br>-Procedures<br>-Rules and regulations | Partner selection<br>Trust (goodwill/capability):<br>-Interaction<br>-Reputation<br>-Social networks |
| *Ex-post mechanisms* | | |
| Performance monitoring and rewarding | Behavior monitoring and rewarding | Trust building:<br>Risk taking<br>Joint decision making and problem solving<br>Partner development |

In the next section we evaluate how information systems technology has supported building these key capabilities.

### 2.2 Emerging ICT Support for Agile Business Networks

Already in 1966, Felix Kaufman published an article in Harvard Business Review that called for experiments with ICT that would cross organizational boundaries [15]. However, studies have shown that decades later ICT may be both an enabler as well as a disabler to agile business networks.

Enterprise Systems Integration projects may take years and huge investments to complete. Connecting legacy and ERP systems of various partners is technically highly complex. The resulting "hard-wired" links often do not enable agile business networks that allow business partners to quickly connect their business processes.

Numerous authors have investigated this issue. For example, a Delphi study by Akkermans et al. [16] revealed that the following key limitations of ERP systems in providing effective SCM support emerge as: "(1) their insufficient extended enterprise functionality in crossing organizational boundaries; (2) their inflexibility to ever-changing supply chain needs, (3) their lack of functionality beyond managing transactions, and (4) their closed and non-modular system architecture".

In a more recent Delphi panel Daniel and White [17] investigate the potential of improved support of inter-organizational linkages by emerging ICT. Their findings suggest that "ERP systems may be reaching a structural limit concerning their capabilities and adjunct technologies will be required to integrate multiple inter-organisational operations". These include a combination of electronic hubs, web services, widespread adoption of common enterprise resource planning (ERP) systems and enterprise portals.

Van Hillegersberg et al. [18] develop a typical virtual organization scenario using webservices and conclude that the technology provides clear benefits: "Webservices will truly allow straightforward B2B integration using standard and low-cost internet technology. This is a major advantage in enabling business networks, as small

companies within these networks usually do not have the knowledge, time and money to implement traditional and complex.

Enterprise Integration technologies…network orchestration could be designed mostly separately from the various systems available in the business network". However, the authors also stress that the orchestration technologies may have scalability and security issues. Furthermore, to truly design a collaborative and intelligent network integration, contracting and collaboration tools are required as well.

**Table 2.** Seven viewpoints of Services as proposed by Allen [19]

| *Viewpoint* | *Description* |
|---|---|
| 1. Transparence: | ▪ Smoothness of the customer's experience in using the service, includes consistency of information. |
| 2. Customer fit: | ▪ Using core competencies to provide customers with excellent products and experiences,<br>▪ Tailoring offerings to customers' needs. |
| 3. Partner connectivity: | ▪ Using third parties to perform commodity services.<br>▪ Offering service(s) to different partners to streamline a business process, improve business relationships or to generate revenue. |
| 4. Adaptation: | ▪ Gracefully adapt the process to changes in the marketplace |
| 5. Multi-channel capability: | ▪ Supporting the customer end-to-end through the process, using different channels to achieve continuity<br>▪ Ability to offer the same service through different channels |
| 6. Optimization: | ▪ Offering services in real time at high performance levels |
| 7. One-stop experience: | ▪ Catering to different needs of the customer through one set of services, typically offered through one channel at one time, often via portals. |

Based on webservice technologies a services paradigm has emerged that promises to better fulfill the need of agile business networks. The services paradigm entitles the transformation of enterprises into modular structures of processes, systems and infrastructure that support the delivery of services. "A service is functionality that must be specified in the business context and in terms of contracts between the provider of that functionality and its consumers. Implementation details should not be revealed" [19]. An ICT architecture that support this services view is referred to as a Service Oriented Architecture (SOA). Allen [19] gives seven viewpoints of a services approach (see Table 2).

While the services paradigm clearly appeals to organizational needs of agile business networks the transformation to a services paradigm and SOA turned out to be a long and winding road for many organizations. For example, Maule and Lewis [20] report on some lessons learned from complex field experimentation with several large scale SOA initiatives over the past 5 years at the US Department of Navy: "the high number of industry participants, and different types of information technologies [many rather unique], mean that transitions can be especially difficult. There are vested interests in legacy systems. SOA requires open architecture; however, it is in closed and proprietary systems that profit is maximized, variables controlled, competitive advantage maintained.". They further state that: New pricing models are required, new ways of assessing risk. This new environment requires new strategies--which have largely not yet emerged. Service-based operations require new day-today operating procedures".

The Software as a Service (SAAS) concept emerged to address some of these issues. SaaS is an on-demand software deployment model where an application is hosted as a service, provided to customers over the Internet. While various definitions of SAAS exist, SAAS typically adds the following elements to the Services/SOA paradigm:

- Hosted: SaaS is a software distribution model in which applications are delivered, maintained and upgraded (i.e., hosted) by a vendor/service provider;
- Network based delivery: Services are delivered to customers over a network, typically the Internet;
- Pay-per-use: SaaS is a subscription-based service model;
- Multi-tenant: A SaaS application typically has a multi-tenant architecture;
- Customization through configuration: A SaaS application is typically configurable, but not customizable.

Many of these core properties of SAAS appeal to businesses active in an agile business network. Benefits that SAAS should bring include focus more on core competencies, access to required technical expertise, system implementation time is shorter with SaaS, more flexible array of payment methods [21]. Cloud computing has tremendously supported the feasibility of the SAAS concept. The virtualization of infrastructures and platforms has enabled SAAS providers to efficiently acquire and scale the resources they need.

Vaquero et al. [22] present the following cloud definitions based on a review of the literature: "Clouds are a large pool of easily usable and accessible virtualized resources (such as hardware, development platforms and/or services). These resources can be dynamically re-configured to adjust to a variable load scale), allowing also for an optimum resource utilization. This pool of resources is typically exploited by a pay-per-use model in which guarantees are offered by the Infrastructure Provider by means of customized SLAs". They distinguish three scenarios where clouds are used: SAAS, Platform as a Service (PAAS) and Infrastructure as a Service (IAAS). In the IAAS scenario, the infrastructure provider, through virtualization, assigns and dynamically resizes these resources to build ad-hoc systems as demanded by their

customers. In the PAAS scenario, instead of supplying a virtualized infrastructure, the providers delivers the software platform where systems run on. Clearly, SAAS providers are often customers of PAAS or IAAS providers.

As enterprises are putting higher priority on agility and joining business networks, the technologies described above have entered the top-ranked priorities of CIO's. Luftman and Zadeh [23] in their recent survey among global organizaitons find that the top-five influential technologies are business intelligence, cloud computing, enterprise resource planning, Software as a Service/Platform as a Service, and collaborative tools.

## 3 Coordination as a Service

In the ultimate agile business network, service providers and consumers can be dynamically added and removed from a business network in short time. Services can be configured on the fly to add value to the network. Service providers are sourced from a global pool of potential providers. Vastly agile business networks have the ability to cost effectively contract service providers to deliver specialized services for a single project or order. Sourcing is not only based on price, but on various quality and risk attributes as well. Moreover, global versus local considerations are included in the selection of each service provider. The selection, contracting and execution of such relationships can be referred to as micro-sourcing.

In section 2, both organizational requirements for agile business networks and current and emerging ICT support for these requirements were described. Table 3 combines the two perspectives. As can be seen in the table, services and cloud computing address some of the requirements but not all. While specialized service providers can use current Software as a Service offerings to develop, configure and publicize their service on a global market place, the dynamic location and integration of these services still requires extensive and time consuming integration. Quick connect capabilities are thus supported only for single SAAS tenants. Whenever a combination of services need to be orchestrated or a portfolio of services needs to be managed services need to be integrated. Coordination and Collaboration, Quick Connect, Relationship and Risk management are not sufficiently covered by the emerging ICT offerings yet.

**Table 3.** Connecting agile network requirements and available ICT support

| Agile Business Network Required Capability | ICT support |
|---|---|
| Modularization of Services, Product, Process | Services, Soa, Saas, Paas, Iaas |
| Coordination and Collaboration Capability | Orchestration languages, tools and Collaboration technologies |
| Quick connect capability | Webservices Integration and Semantic Standards, SAAS |
| Relationship Management Capability | Service Quality Attributes and SLA |
| Risk Management Capability | Monitoring tools, Performance management tools |

We therefore propose a fourth layer to be added to the "as a service" stack: Coordination as a Service (CAAS) (Figure 1). Coordination as a Service is a set of coordination services that can be rented from the cloud for the purpose of achieving agile service integration. The CAAS provider offers a platform that support Coordination and Collaboration, i.e. capabilities to search and compare services, orchestrate services in using various intelligent and pre-configured scenario's. In addition to structured collaboration the CAAS platform also offers "soft" collaboration for service contract negotiation and price agreements. Relationship management capabilities are supported by the definition and monitoring of joint performance indicators and goals. The CAAS also offers conflict resolution capabilities. Risk management tools and monitoring tools are supported to assess and mitigate risks in the relationship.

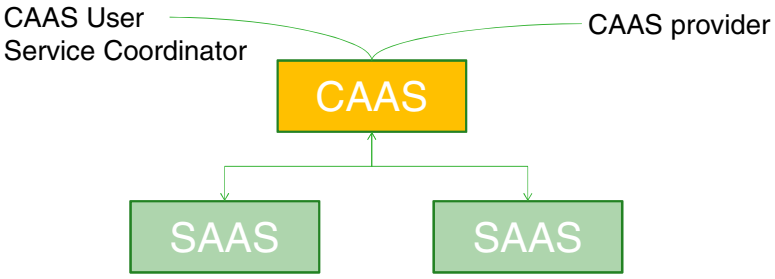


**Fig. 1.** Coordination as a service (CAAS)

We envisage Specialized Coordination as a Service providers that will offer various combinations of technical and organizational support to aid businesses in creating cost effective and dynamic integrations. These CAAS will be not have any physical assets but entirely focus on the described capabilities. The business models of CAAS providers could vary, but also follow a pay per use format. Strategies of CAAS providers are also likely to vary following either an operational excellence model (coordinate services efficiently), customer intimacy (coordinate services in close contact with the customer providing optimal service) or an innovative strategy (lead in using advanced coordination technologies).

## 4 Early Developments

In The Netherlands we identified several cases of emerging projects which hint at the realization of the above introduced concept of Coordination-as-a-Service. We would like to discuss two in particular.

Hubways is the first example. Hubways is an initiative from FloraHolland, its members (growers) and parties involved in the trade and transportation of flowers from, to, and between the (Dutch) flower auctions. Hubways, started off as a project to analyze the potential of creating a more intelligent transportation process for flowers that are transported between the six auctions of FloraHolland. Being the

largest flowerauction in the world, the inter auction flows accumulate up to a volume which keeps over 400 trucks busy every day. Outcome of the first phase of the project: the observation that a serious amount of trips and therewith number of trucks utilized could be reduced by better coordinating transportation. Designing and developing a (software based) coordination platform became focus in the second phase of the project. Currently, the project is in its third phase in which the software is put in place and first try outs get scheduled. Important design foci were and still are:

- Quick connect and disconnect of business partners
- Event driven architecture (sense and respond)
- Learning from the past (real-time data analysis / pattern recognition)
- Largely autonomous environment, which can run with limited amount of human intervention

Important to mention is that Hubways specifically aims at the establishment of a wider applicable reusable system, which could be applied outside the specific scope of inter-auction physical transport streams as the consortium beliefs that coordination is a need in many inter-organizational networks.

Business network coordination has been a topic of interest within the fields of logistics and supply chain management for decades. Operating at the intersection of science and practice, Dutch Logistics Topinstitute Dinalog positioned the so-called 4C – which stands for Cross Chain Control Centre – centrally in its research agenda. A series of research projects was initiated to establish 4Cs, either physical ("an overall supply chain cockpit") or fully virtual. One of the companies collaborating with Dinalog is Tri-Vizor, a University of Antwerp spin-off firm. which develops a software platform to enable a minimally manned control center. Tri-Vizor aims at supply chain orchestration at both the strategical, tactical as well as operational level across multiple supply chains for its customers. Their software and processes focus on:

- Quick connect and disconnect of partners (and entire supply chains)
- Strategic analysis and sourcing processes get follow up by tactical monitoring and operational real-time control – all in one environment, accessible via their Cross Supply Chain Cockpit
- Active SLA monitoring (of contracts)

A first implementation of their processes and tools is done for two collaborating pharmaceutical firms, eachother's direct competitors: Baxter and UCB. Tri-Vizor is very actively extending its services and looking for new cross chain orchestration opportunities.

Both examples are still under development, and still have to prove their real market value. Nevertheless, they underwrite our thesis that Coordination-as-a-Service is a new domain with potential.

## 5 Conclusions and dicussion

In this paper we address the emerging trend of agile business networks. While these networks have received increasing attention in literature their large scale implementation is hindered by the lack of proper ICT support. To investigate how emerging ICT addresses the need of agile business networks we explain the characteristics of such networks based on the literature. We find that ICT today offers many paradigms and technologies to support the creation of agile business networks. Where traditional legacy and ERP systems fell short, SOA, cloud based technologies and services are more and more meeting the organizational requirements. However, the comparison of requirements and ICT offerings reveals that coordination and collaboration capabilities, quick connect of multiple services and relationship and risk management capabilities lack ICT support in a 'as a service" model. We introduce Coordination as a Service to address this need.

In future research the aspects of CAAS will be described in more detail and early examples will be surveyed. Case studies and design studies will be conducted to investigate how CAAS in combination with the growing SAAS market can support successful agile business networks.

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