Informing business strategy through extension of the multi-organisational service network *concept of operations* approach

Tomás Seosamh Harrington
tsh32@cam.ac.uk
Institute for Manufacturing, University of Cambridge, UK

Jagjit Singh Srai
Institute for Manufacturing, University of Cambridge, UK

Abstract
Concept of Operations (ConOps) terminology has been used in many operational contexts where multiple equipment and service providers operate in a shared environment. The approach has previously been applied, predominantly from a multi-organisational network/inter-firm perspective, in the design and operation of product-service systems. This paper looks to extend the *ConOps* approach to an overall business strategy context, by examining the strategic intent of intra-firm networks. Focus specifically centres on general drivers and characteristics, how they may be influenced by internal and external factors and the subsequent effect on network configuration and capabilities.

Keywords: Product-Service Systems, Networks, ConOps

Introduction

Many manufacturing firms have developed a service dimension to their product portfolio. In response to this trend, organisations (often involved in complex, long-lifecycle product/system provision) need to reconfigure their global networks to support integrated product-service offerings. However, existing approaches to the design and global operation of service networks continue to be largely product-oriented, paying little attention to the more customer-facing, relationship-based and complex partnering nature of services.

Concept of Operations (ConOps) terminology has been used in many operational contexts where multiple equipment and service providers operate in a shared environment. It can provide an overview, as well as a strategic objective of an operation or series of operations, based on a definition of the roles and responsibilities of all the related parties in an organisation or network. A *ConOps* approach for multi-organisational networks (MON) has previously been reported and applied, predominantly from an inter-firm perspective, in the design and operation of product-service systems (Harrington and Srai, 2012a; Harrington and Srai 2012b). However, networks within different contexts will have different strategic objectives. Analyses of existing ConOps models looked at the identification and codification of elements applicable to all stakeholders through which

organisations and networks can develop such specific operational guidance, tactics, techniques and procedures. In summary, the *ConOps* approach developed involved:

- Understanding the business and operational context: defining strategic intent and priorities across e.g. design, build, service and support cycles
- Establishing network operating principles as part of a high-level network configuration design: informed by the literature on configuration models used in engineering, production, service and supply networks
- Identifying, aligning and integrating processes across the specific network to achieve operational objectives: supported by process mapping approaches that were used to identify network critical processes, particularly those processes key to service network integration.

This paper looks to extend the *ConOps* approach to an overall business strategy context, by examining the strategic intent of intra-firm networks. Focus specifically centres on general drivers and characteristics of industrial systems, how they may be influenced by internal and external factors (e.g. market, product, production system, technology, policy, people and culture) and the subsequent effect on network configuration and capabilities. At a practice level, this research may support organisations in effectively aligning e.g. a future engineering service-specific strategy with that of the overall business.

Literature Review

The next sections summarise the literature used in constructing the ConOps framework approach. The framework represents the operational elements of service and supply networks from the perspectives of contextual environments, organisational features, processes and capabilities. It extends the theoretical understanding of network organisations from a product perspective, towards that of services and aims to aid industries involved in complex equipment provision to design and operate their product-service networks.

Industrial Context

Research has previously used two dimensions to differentiate business/organisational environments: complexity and dynamism (Child 1972; Duncan 1972; Sia *et al*, 2004). Complexity refers to the heterogeneity and range of environmental activities, which are relevant to an organisation's operations (Child 1972). It can be measured by whether the environment leads to difficulties in gathering sufficient and necessary information, analysing the causes and effects, or predicting the trends and outcomes (Sia *et al*, 2004). Dynamism refers to the degree of change, which characterises environmental activities relevant to an organisation's operations (Child 1972). It can be measured by the rapidity of changes, or the number of possible outcomes in the environment (Sia *et al*, 2004). Networks within different contexts will have different strategic objectives. In this

approach industrial context is extended to refer to the environmental features of network organisations, which are influenced by internal and external factors e.g. institutional trends, industrial trends and firm level strategies and informs '*target outcomes'* and '*contextual environments of operations'*, e.g. the constraints, key problems, current situation or background, for the ConOps framework.

Network Configuration

The network configuration approach used focuses on establishing patterns or profiles. Firm-based configuration concepts are widely recognised in the strategic management and organisational structure literature. Strategic management literature has identified different types of configurations with distinguishable strategic objectives, target markets, critical resources, and operational behaviors (Chandler 1962; Khandwalla 1970; Rumelt 1974; Miles *et al*, 1978; Mintzberg 1979; Miller 1996). Firm configurations are usually described by the characteristics of organisational structures and coordination mechanisms (Chandler 1962; Mintzberg 1979; Miller 1996). Mintzberg (1979) considered configuration as a combination of certain characteristics of structure and situation which organisations naturally fall into. Organisations will not function effectively when such characteristics are mismatched. Organisational elements should be logically configured into internally consistent groupings because they are usually interrelated in complex and integral ways (Miller 1986). Firms may be driven towards common configurations to achieve internal harmony among elements of strategy, structure and context (Miller 1986). Cohesive configurations are composed of tight constellations of complementary and mutually reinforcing elements, which could be predicatively useful because the number of possible ways in which constructional elements are combined is reduced. With this viewpoint, configuration can be viewed as a constellation of organisation elements that are pulled together by a unifying theme. The description of configuration includes a firm's core mission and its fundamental means to accomplish the mission in a certain market, and the systems, processes, and structures to support the core operations.

In recent years, business activities are increasingly dispersed across geography and ownership boundaries. There is a growing research community working on network configurations, especially in operations management and strategic management (Shi *et al*, 1998; Bozarth *et al*, 1998; Oltra *et al*, 2005; Zhang *et al*, 2007; Srai *et al*, 2008). Shi *et al* (1998) contended that the dispersion and coordination of manufacturing networks require different international manufacturing capabilities from the perspectives of efficiency, mobility, resource accessibility and learning ability. The dispersion dimension refers to the structure of a network; and the coordination dimension emphasises on the relationship between network members. Zhang *et al* (2007) identify four types of contextual environments of global engineering networks; capturing the core capabilities of engineering networks in each context and demonstrated the organisational features to deliver the capabilities. Engineering network configuration has been described from the perspectives of network structure, governance and coordination, and support infrastructure. The research introduces two new dimensions - governance system and support infrastructure, which have strong relationships with the capability and context of engineering networks. Srai *et al* (2008) describe the configuration of supply networks

from the perspectives of network structure, flow of information and material between/within operation units; relationships between network partners; and product structure. The research highlights the importance of relationship with internal and external partners. Although different type of 'products' demand different network capabilities, hence the network configuration to deliver the capability, product configuration also plays a key role in service network dynamics.

The literature demonstrates the evolving process in understanding the organisational features of different types of networks, including intra-firm and inter-firm operations for manufacturing, engineering and service supply chain functions.

For an engineering network (in a product-service context) involving multiple players, taking a multi-organisational perspective, these individual research strand inputs can be usefully integrated as:

- Structure: to describe the geographical footprint of a network, including the dispersion of network units and their interdependence, characterised by the degree of dispersion (dispersed v. concentrated), and the interdependence between centres (independent v. interdependent).
- Network Dynamics: to describe the operational processes adopted by network members, characterised by their degree of standardisation (standard v. tailored /bespoke).
- Governance and Coordination: to describe the governance system and coordination mechanism of a network, characterised by their degree of centralisation.
- Support infrastructure: to describe support infrastructures of a network, including IT systems, resources, people, and cultures, characterised by their degree of unification (uniform v. customised) and globalisation (global v. local).
- Relationships: to describe the linkage between network members, e.g. customers, suppliers and users, characterised by their strategic importance (strategic vs. tactical), degree of trust (trust vs. transactional), and scope (global v. local).

The term 'network' here covers the operational unit of analysis under study – this can be a single function or combination of engineering, production, supply network and service across the manufacturing value chain, which can inform *'organisational structure'*, *'relationship with partners'* and 's*upport infrastructure'* aspects of the ConOps framework.

Network Integration

A methodology for identifying industrial network integration processes across multi-organisational networks has been developed (Iakovaki *et al*, 2009) and includes a process hierarchy, which helps to support the integration of business, strategic and operational drivers, as well as to support the development of shared goals across the network. Despite an inherent complexity, integration challenges can be narrowed down to key processes or 'linkages' between partners. Preliminary results informing this research demonstrate that

the evaluation of these operational processes against a set of network integration enablers i.e. *Common Goals, Shared Risks and Rewards, Network Synchronisation, Collaborative Resources, Knowledge Sharing,* informed by literature and tested within an operational environment, can help identify critical process-based capabilities in multi-organisational service networks (Iakovaki *et al*, 2009). Adaptation of these process hierarchy and network integration methodologies can inform the '*operational processes*' aspect of an emerging ConOps framework. While previous ConOps models broadly identify key elements, they are not properly defined. The approaches of network configuration and processes key to network integration, identified in this paper, provide a standard definition of the main elements of a ConOps (i.e. *target outcomes, contextual environments, organisational structure, relationship with partners, support infrastructure and operational processes*)

Methodology

The approach involved applying the *ConOps*, developed for multi-partner networks, with supporting methodologies, to examine industrial context, potential engineering service network configuration options and the capabilities required to support effective delivery of engineering service and overall business strategies. Figure 1 summarises the network context approach used to examine institutional trends, industrial trends and firm-level strategies and effect on capabilities, configuration and the overall network.

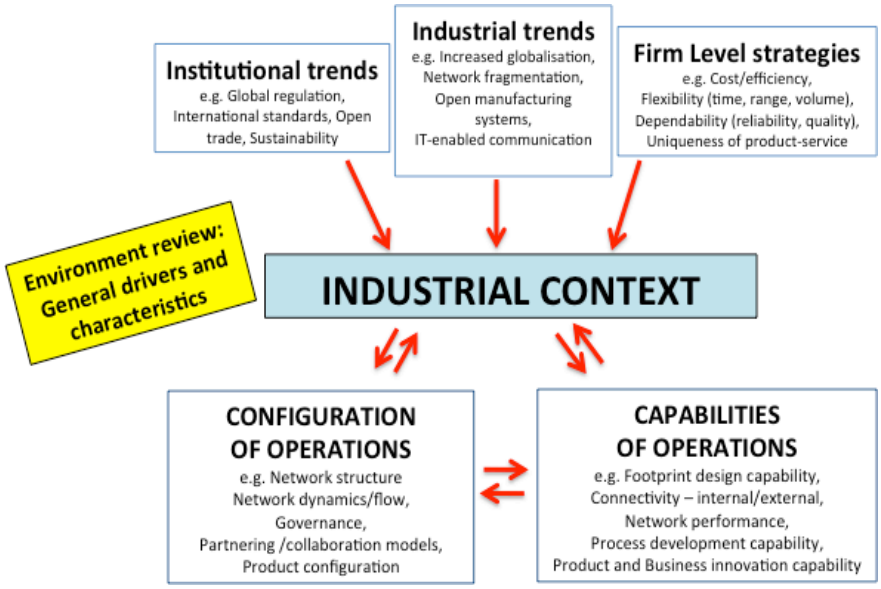

Figure 1. Network context approach used to examine institutional trends, industrial trends and firm-level strategies and effect on capabilities, configuration and the overall network.

The process first involved an external benchmark review of seven exemplar 'network organisations' involved in large engineering and service contracts across four industry sectors (see *table 3*). As networks within different contexts will have different strategic objectives, these preliminary case studies were conducted in order to (a) understand internal and external factors, e.g. *institutional trends, industrial trends* and *firm level strategies* from different perspectives, and (b) examine how these external factors impacted on configuration and capabilities.

The *ConOps* approach was then refined and tested in engineering service network and overall business strategy contexts, using in-depth case studies which spanned:

- 3 organisations involved in complex product equipment manufacturing and service provision
- 10 diverse networks operating within multi-entity service supply chains, providing services on-site across 6 lines of business and >60 global locations

With the in-depth case studies, the ConOps approach specifically explored:

- how factors impact on both dimensions of network configuration, capability and global engineering service operations.
- Understanding the business and operational context: defining strategic intent and priorities across e.g. design, build, service and support cycles
- Establishing network operating principles as part of a high-level configuration design
- Identifying, aligning and integrating processes across the network to achieve operational objectives

Results Summary

High-level generic findings from the in-depth case studies are summarised in tables 1 and 2. Key findings include the need for:

- *Increasing Flexibility***:** cross-business unit challenge to be 'more flexible, leaner and faster', to better utilise skills set of engineers e.g. experience, capabilities, and disciplines.
- *Increasing Relationship Management***:** greater focus on relationships, individuals and working methods to balance technical, projects/business with partnership working.
- *Working in Partnership/New 'Engineering' Roles***:** reflected in growing importance of softer skills with new roles emerging particularly related to "co-ordination".

Table 1. Informing Business Strategy through ConOps approach – Current Networks

Application of ConOps: Current Characteristics (common to in-depth case study networks)	Informing Strategic Drivers
Business priorities identified include common (design) systems & resource optimisation	Increasing Flexibility - Business challenge to be 'more flexible, leaner and faster', utilise skills set of Engineers e.g. *experience , capabilities, disciplines*
Established capabilities and capability targets are based on target locations	'Efficient/Effective Operations'
In terms of Capability, move from internal competencies towards e.g. 'Intelligent purchasers' - individuals /teams with ability to understand both the 'technology' and work closely with partners.	Increasing Relationship Mgmt - greater focus on relationships, individuals and working methods to balance technical, projects/business with partnership working.
Capability focus – gaining familiarity with common systems given a need to increase Eng. knowledge in areas outside of specific specialisms.	'Futuring Process' – the need to offset skills shortage of engineers and 'futuring process' in tackling changing demands of the technical skill base
Eng. continuing to be project driven: with added need for an appreciation of other disciplines and ability to handle customer interface.	Increasing Flexibility, Increasing Relationship Mgmt
Eng roles – shift from 'technical specialist' to 'partner working'. Continued Eng teams working with external parties/different cultures.	Increasing Relationship Mgmt - Engineering must handle customer interface and work alongside customers.
New Eng roles emerging in e.g. product lifecycle Mgmt.	Sustainability with lifecycle analysis' -Effective handover and feedback between lifecycle stages (e.g. Design -> Manufacture and In service feedback -> Design etc)

Table 2. Informing Business Strategy through ConOps approach – Future Networks

Application of ConOps: Future Characteristics (common to in-depth case study networks)	Informing Strategic Drivers
Governance largely central.	Hub & Spoke model favoured – emergence of global/virtual/functional engineering communities of practice, with greater emphasis on responsibility allocation
Configuration heavily driven by skills mismatch	Skills gap - Location skills have increasing influence, as a global capability 'lead' while regional engineering hubs are built up
Location driven by closeness to manufacturing sites with development of global mindset e.g. global communities of practice	Drivers seen as "Resource-People-Location-Cost"
	"Buy-in that global networking was not about 'just' about cost reduction"
	"Speed to market critical…more critical than cost savings"
Location skills used as a source of global capability, multiple sites supported by central engineering function with best practice transfer using a CoE model.	"…cost not the major driver"
Internal partnering considerable with focus on adapting internal processes	Increasing Flexibility, Resource Optimisation
New roles emerging particularly related to "co-ordination"	Working in Partnership - reflected in growing importance of softer skills.
Engineer transfer to other functions to do different role, a favoured approach	Increasing Relationship Mgmt - greater focus on relationships, individuals and working methods to balance technical, projects/business with partnership working

Table 3. External benchmark review of Engineering Service Functions (Inter- and Intra-firm focus)

Model A	Model B	Model C	Model D	Model E	Model F	Model G
- Critical external drivers include regulation/future compliance, sustainability and export growth. - Major trends which impact current business include supplier rationalisation, Tier 'shift' and increased globalisation. - Business priorities identified include greater empowerment, investment in people to address skills gap. - Approach to Capability is leading to global/virtual/ functional engineering communities of practice with greater emphasis on responsibility allocation - Configuration heavily driven by Partnering, drivers recognised as being resource-people-location-cost, with cost not the major driver. Responsiveness to the market and dynamics seen as critical. - New roles of functional specialists capable of networking across an organisation emerging	- External drivers largely safety and environmental based. - Current major trends impacting business centre on sustainability coupled with lifecycle analysis, MFG transfer to low cost economies and reverse flow of products to traditional markets. - Key business priorities primarily involve working closely with customers, with greater emphasis on supplier partnering. - Location driven by closeness to customer. Speed to market critical (de-centralised) viewed as more important than cost savings (centralised) - Configuration heavily driven by Global network. Use of Competency Centre-type concepts popular with Strategy and/ or Global Teams linking these global networks. Critical to benefit from expertise in various regions. - Large focus on people working in partnerships	- Critical external drivers include legislation, sustainability, urbanisation and export growth - Current business trends centre on growth of customers and projects demanding more 1:1 attention. - Business priorities identified as cost reduction and maintaining a quality differentiated product. Service element currently secondary. - Governance largely central. Location driven by closeness to manufacturing sites with development of global mindset e.g. global communities of practice - Internal partnering considerable with focus on adapting internal processes - New roles emerging particularly related to co-ordination, reflected in growing importance of softer skills	- Critical external drivers centre on transfer of MFG to low cost economies. - Trends impacting current business include market access & decision on traditional geographys. - Business priorities centre on Make vs. buy, outsourcing of e.g. develop't to 3rd parties, cost efficiency in emerging markets and addressing the skills gap. - Key issue is the potential surplus of engineering skills in traditional markets vs. shortage of qualified experienced people in new markets. - Configuration heavily driven by skills mismatch: Location skills used as a source of global capability Multiple sites supported by central engineering function with best practice transfer using a CoE model. - Engineer transfer to other functions to do different role, a favoured approach	- Critical external drivers centre on the poor skill set of Engineers. - Current business drivers focus on the need to become more flexible, leaner and faster. - Business priorities identified include the more effective use of common processes and data . - Established capabilities and capability targets are based on target locations. Greater focus on relationships, individuals and working to wards more strategic long-term partnerships. - Competitiveness seen as being driven by network configuration dimensions identified. - Cross functional teams/ roles in operation led by Engineering e.g. Transformation project team/product delivery team.	- Critical external drivers centre on shift towards open innovation. - Major trends which impact current business centre on shift towards collaborative innovation with partners. - Business priorities shifting from technology driven products to a marketing focus - In terms of Capability, moving from internal competencies towards e.g. 'Intelligent purchasers' - individuals / teams with ability to understand the technology AND work closely with partners . - New approaches to Configuration with less contact/ lower synergies between R&D and Manufacturing . Stronger links between R&D, Marketing & other technology groups - Eng roles: shift from 'technical specialist' to 'partner working ', need for people with both technology and relationship skills. More EQ (Emotional quotient) e.g. degree of success in personal relationships than IQ	- Critical external driver is IP preservation. - Current business trends centre on (a) existing customers - enhanced productivity & quality (b) emerging markets - support focus. - Business priorities identified include common (design) systems, resource optimisation and overseas investment to preserve IP & 'know-how'. - Capability focus: gaining familiarity with common systems given a need to increase Eng. knowledge in areas outside of specific specialisms. Continued Eng teams working with external parties/different cultures. - Configuration model based on shift of selected eng activities to low cost locations. Given IP concerns outsourcing unlikely to feature. Future need for increased servitisation will change the nature of operations (From OEM to a greater service footprint.) - Eng. will continue to be project driven: with added need for an appreciation of other disciplines and ability to handle customer interface. No new positions beyond those of e.g. product lifecycle Mgmt.

Discussion

This research extends key elements of a 'concept of operations' for multi-organisational networks to an intra-firm context, in order to align engineering service and overall business strategies. The research contributes to the understanding of how best to design networks and provides guidance for organisations on the operating principles and protocols to be used. This paper specifically informs the defined ConOps elements of 'target outcomes' and the 'contextual environment', capturing the constraints, key problems, current situation or background and future trends within the context of particular networks. Associated *ConOps* methodologies employed to align network configurations and capabilities also provide theoretical insights on product-service archetypes, which may support the implementation of future integrated product-service strategies. At a practice level, the approach supports engineering service network strategy development and may enable greater alignment with the strategy of the overall business. The application of the *ConOps,* as part of the in-depth case studies, has demonstrated:

- An ability to specify networks in terms of a '*concept of operations*' and define network and business-wide principles of operation (seven models emerging – see table 3)
- The approach, previously applied extensively in an inter-firm context, is equally applicable in an intra-firm context, providing a common language, which enables the wider business, and different functions/intra-firm networks to better communicate with each other to achieve consensus or identify common problems.
- Enables organisations to identify the critical issues in the process of network transition.
- *ConOps* methodologies demonstrate a high-level vision of a company's overall network through segmentation into manageable elements.

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