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

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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 ‘support 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.

![Diagram of Industrial Context](image)

*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”.

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Table 1. Informing Business Strategy through ConOps approach – Current Networks
### Application of ConOps: Current Characteristics (common to in-depth case study networks)

| 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) |

### Application of ConOps: Future Characteristics (common to in-depth case study networks)

| 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 |

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Table 2. Informing Business Strategy through ConOps approach – Future Networks
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<tr>
<th>Model A</th>
<th>Model B</th>
<th>Model C</th>
<th>Model D</th>
<th>Model E</th>
<th>Model F</th>
<th>Model G</th>
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</thead>
<tbody>
<tr>
<td>- Critical external drivers include regulation/future compliance, sustainability and export growth.</td>
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<td>- Critical external drivers include legislation, sustainability, urbanisation and export growth</td>
<td>- Critical external drivers centre on transfer of MFG to low cost economies.</td>
<td>- Critical external drivers centre on the poor skill set of Engineers.</td>
<td>- Critical external driver is IP preservation.</td>
<td>- Critical business trends centre on (a) existing customers - enhanced productivity &amp; quality (b) emerging markets - support focus.</td>
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<td>- Major trends which impact current business include supplier rationalisation, Tier ‘shift’ and increased globalisation.</td>
<td>- 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.</td>
<td>- Current business trends centre on growth of customers and projects demanding more 1:1 attention.</td>
<td>- Trends impacting business centre include market access &amp; decision on traditional geographies.</td>
<td>- Current business drivers focus on the need to become more flexible, leaner and faster.</td>
<td>- Business trends include common (design) systems, resource optimisation and overseas investment to preserve IP &amp; ‘know-how’.</td>
<td>- Capability focus: gaining familiarity with common systems given a need to increase Eng. knowledge in areas outside of specific specialties. Continued Eng teams working with external parties/different cultures.</td>
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<td>- Business priorities identified include greater empowerment, investment in people to address skills gap.</td>
<td>- Key business priorities primarily involve working closely with customers, with greater emphasis on supplier partnering.</td>
<td>- Business priorities identified as cost reduction and maintaining a quality differentiated product. Service element currently secondary.</td>
<td>- Business priorities centre on Make vs. buy, outsourcing of e.g. develop to 3rd parties, cost efficiency in emerging markets and addressing the skills gap.</td>
<td>- Business priorities identified include the more effective use of common processes and data.</td>
<td>- Established capabilities and capability targets are based on target locations. Greater focus on relationships, individuals and working towards more strategic long-term partnerships.</td>
<td>- 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.</td>
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<td>- Approach to Capability is leading to global/virtual/functional engineering communities of practice with greater emphasis on responsibility allocation</td>
<td>- Governance largely central. Location driven by closeness to manufacturing sites with development of global mindset e.g. global communities of practice</td>
<td>- Key issue is the potential surplus of engineering skills in traditional markets vs. shortage of qualified experienced people in new markets.</td>
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<td>- Business priorities shifting from technology driven products to a marketing focus</td>
<td>- New approaches to Configuration with less contact/lower synergies between R&amp;D and Manufacturing and stronger links between R&amp;D, Marketing &amp; other technology groups</td>
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<td>- 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.</td>
<td>- Location driven by closeness to customer. Speed to market critical (de-centralised) viewed as more important than cost savings (centralised)</td>
<td>- Internal partnering considerable with focus on adapting internal processes</td>
<td>- - Location 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.</td>
<td>- - Cross functional teams/roles in operation led by Engineering e.g. Transformation project team/product delivery team.</td>
<td>- - 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.</td>
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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.

References


