
Global supply chains as holistic systems: an expanded perspective

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Abstract: Global supply chains are a dominant theme in business academic literature. Most writers purport a holistic perspective. Our review of their literature found this untrue. Their focus on primary players excludes other relevant agents that make significant contributions to supply chain performance. We present a holistic three-layer model: primary players, infrastructure enterprises and a third layer of governance and an array of organisations, such as unions, financial institutions, and NGOs, all embedded in their surroundings that continually change as products/services move to final users. Strategic planning for global supply chains must include relevant agents from all three layers and their surroundings to be effective. Our literature review and holistic three-layer model address this problem.

Keywords: global supply chain; GSC; holistic; complex; dynamic; adaptive; hard and soft infrastructure; governance organisations; surroundings; integrated strategy; information sharing; collaboration; logical layers; paradigm.

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1 Introduction

World exports are experiencing significant growth as a percentage of World gross domestic product (WGDP) which is expected to reach 13.5% of world trade in 2010 (WTO, 2010), an apparent irreversible trend, except for down years like 2009. As global supply chains (GSCs) expand to support this growing trend they face interesting challenges in growth, adaptation, strategic planning and daily decision-making throughout the entire value stream. Our purpose is to expand the present GCS paradigm to embrace a holistic perspective – horizontally, vertically and inclusive of those organisations and agents that function in parallel to GSCs, such as the underpinning of hard infrastructure networks, including their surroundings. From what we define as a multi-layered GSC system the primary players, infrastructure enterprises and governance organisations, should, for effective strategic planning, be inclusive of these tertiary entities. To date professional and academic literature has focused on just one of these categories – primary players. Although many writers recognise the need for interconnectedness and to function as a strategic whole, there is meagre identification or discussion of those entities that make up significant elements of GSCs: infrastructure enterprises and governance organisations, much less the tertiary elements that impact

GSCs (see, for example, these highly respected sources: HBR on SCM 2006; Slone et al., 2010). Our paper addresses this issue: identifying significant elements in each of the three layers, including their surroundings, then suggesting a holistic model that brings them into a networked system, closely related to contingency theory models where decision-making usually occurs with 'soft' rather than static information (Stonebraker and Afifi, 2004).

GSCs are continually evolving, interacting with expanding globalisation. Our own thinking of GSCs has evolved as well becoming more holistic and complex as suggested in earlier writings (see Neace, 2008; Neace and Saxena, 2003a). We continue to develop and extend on these concepts of holism and complexity leading to a paradigm shift in GSC management.

First layer primary players of GSCs are networks of firms the literature has traditionally recognised as the 'GSC.' They are presented in this paper as 'strategic alliance systems', dynamic and demand-driven. A second layer of GSCs are defined as 'infrastructure enterprises'; the basic hard and soft entities of GSCs, such as major logistic hubs like the twin ports of Los Angeles-Long Beach, or the fast growing sector of 3PL firms so necessary in today's technology-driven world. Both hard and soft infrastructure enterprises are very intertwined with first category primary players. A third layer consists of the many systems of governance at four levels: local, regional, national and global; most often concerned with safety, security, health issues and economic stimulus. This stratum also consists of an array of organisations that often play important roles in moving and sustaining GSCs and communities, such as NGOs, unions and community organisations. For example, safety, security and health activities present GSCs managers interesting concerns – what metrics should be used to measure their contribution to 'value created'? It is well recognised they add costs. A fourth area of importance in transitioning toward a holistic GSC paradigm are their surroundings, the interactions and boundaries of locations/environments where GSCs operate; for example, 'hard infrastructure' – roads, bridges, canals, energy grid systems (e.g., DeAngelis, 2011), as well as community business climates and education systems, to name a few, nor does the global supply chain management (GSCM) literature account for these 'surrounding' factors. All four areas are very intertwined, always evolving and adapting and make up the totality of GSCs and their environments. Recognising the holistic extent of primary players, infrastructure, governance and surroundings in these global, multi-agent value systems is necessary for effective, integrative, strategic decision making by GSC managers. GSCM and its myriad of activities do not occur in a vacuum.

Information for our study comes from two sources: first, years of observation of GSCs and discussions with officers, officials and agents across a broad range of entities; including container ports and their hubs; airports; transport/logistics firms – trucking and airline firms; export-import brokers; warehousing and distribution enterprises; government agencies at local, national and international levels; and NGOs at the international level. An extensive literature review, including several disciplines outside traditional GSC literature, is the second source of information.

The result is a divergence: our observations and personal contacts view GSCs as much broader, more inclusive, more holistic than did our literature searches, in which most writers view GSCs as networks of primary players at the exclusion of infrastructure enterprises, governance organisations and relevant agents from the surroundings where GSCs exist. A GSC model (Figure 1) is presented after our literature review. Both address this issue leading to a paradigm shift of GSC management.

2 Background

World gross domestic product (WGDP) has grown steadily (2% to 4% a year) from 2000 through 2010; whereas exports have grown during this same period of time from 3% to as much as 13.5% a year. Except for 2001 and 2009, when both WGDP and trade exports fell due to the global economic recession, trade exports over this past decade have far exceeded WGDP growth (WTO, 2010). GSCs including their infrastructures have paralleled this surge in global economic activity. As more and more economic goods and services cross international borders so does their governance – at four levels: local, regional, national and ‘globally’. Globally, these protocols, rules, regulations and their administration are interjected throughout GSCs by organisations such as NAFTA, European Union, WTO, ASEAN, MERCOSUR and the UN, to name a few. We make the case that GSCs are multi-layered, consisting of primary players, infrastructure enterprises, governance organisations and the surroundings in which they exist. GSCs often traverse through several different surroundings, complicating the lives of GSC managers at all levels. Scholarly literature of GSCs is focused on primary players, the large multi-national enterprises, with only token attention to second and third layer organisations: the hard and soft infrastructure and governance of the everyday life of global economic activity. We found scant attention to any impact of the surroundings: for example the impact of the expansion of the Panama Canal. This event will impact all elements of GSCs moving goods and services to and from North America. The literature is bifurcated: on one hand it recognises the need for integrated decision making; on the other it is focused on management and integration of primary players. According to contingency theory, during dynamic periods of change, supply chain organisation structure choices provide interesting challenges to their managers due to uncertainty (Guide et al., 2003; Stonebraker and Afifi, 2004). When surroundings are stable and deterministic mechanistic models with centred management and standardised procedures, both micro-macro, are often the structure of choice. When surroundings are dynamic and unpredictable, organic models with high adaptive qualities and metastable equilibrium are better models of choice. We believe the latter provides a better structured model of choice considering the dynamic complexities of GSCs (Govindan and Wilson, 2008).

First layer primary players of GSCs are networks of firms the literature has traditionally recognised as the ‘GSC’. They are presented in this paper as ‘strategic alliance systems’, dynamic and demand-driven. A second layer of players of GSCs are defined as ‘infrastructure enterprises’; the basic hard and soft entities of GSCs, such as major logistic hubs like the twin ports of Los Angeles-Long Beach or the fast growing sector of 3PL firms so necessary in today’s technology-driven world. Both hard and soft infrastructure enterprises are very intertwined with first layer primary players. A third layer consists of the many systems of governance at four levels: local, regional, national and global; most often concerned with safety, security, health issues and economic stimulus. This stratum also consists of an array of organisations that often play important roles in moving and sustaining GSCs, such as NGOS, unions and community organisations. For example, safety, security and health activities present GSCs managers interesting concerns. What metrics should be used to measure their contribution to ‘value created’? It is well recognised they add costs. There is a fourth element to our holistic model – the surroundings: the interactions and boundaries of the many tertiary environments GSCs flow through to reach their final destinations: for example, availability of appropriate labour and community long-term development plans.

For an excellent discussion of value creation and integration among primary players in GSCs, see, Slone et al. (2010). This excellent book has two short-comings – it is focused on primary players – just one layer; and inattention to infrastructure enterprises (e.g., supply chain hubs, global container ports), governance organisations (e.g., NAFTA, EURO, ASEAN, UN, plus the laws, rules and regulations from the many trading countries – of which there is much room for conflict), as well as their surroundings, from strategic decision making in GSC literature is short-sided. Second, as stated above, there is no recognition of the complex uncertainties that are a part of every-day life of GSCs. Our research shows clearly, major enterprise agents from the second layer often move from being supporting players to becoming primary players: for example, UPS and DHL, global carriers for many primary level organisations, in expansion moves developed healthcare facilities in several major countries to meet the evolving demands of pharmaceutical, biotech and medical device companies (Gallagher, 2011; Miller, 2011). We claim all layers and their surrounding should be included in strategic decision making with GSC managers of primary players. Their inclusion in strategic planning and decision making leads to ‘holistic’ schemas in sustaining flows and creating value seamlessly from sources to end users. Castells (2000) and others (e.g., Neace and Saxena, 2003b; Prahalad and Krishnan, 2008) claim GSCs should be the basic unit of analysis, not traditional, large multi-national enterprises. In this ‘new’ global economy production of goods and services is increasingly performed by transnational networks of many players’ not just multinational corporations. A model is presented and discussed that attends to this issue: a macro overview of holistic supply chain systems, identifying major players of all three layers and their surroundings. GSC managers are responsible for planning, organising and strategically blending this ‘basket’ of dynamic, always evolving, agents, entities and surrounding environments into value-generating supply chains – to sustain flows, to attain strategic goals.

Two distinctions should be made prior to further discussion. First, there is a significant difference between supply chains and supply chain management (SCM). Supply chains are linked processes – they exist whether managed or not. SCM is open, definitive action on the part of individuals, in this case supply chain managers, to develop, collaborate and maintain networks of activities that create flows of value from sources to end users (e.g., Mentzer et al., 2001; Cooper et al., 1997). Second, there is a distinction between SCM and GSC management, often overlooked in the literature. Globalisation adds several dimensions that complicates lives of supply chain managers whose task is creating smooth, collaborative sustaining flows of value throughout their GSC networks: longer supply chains increase risks and vulnerabilities, as does economic and political volatility (Gyorey et al., 2010; Paulonis and Norton, 2008), more time zones, potential for language miscues, multi-culture issues – how ‘work’ is performed, currency fluctuations, need for virtual communications, streams of new technologies both soft and hard, availability-capacity-capability of infrastructure units, and governance (often multiple, sometimes conflicting and not always cooperative or effective) – as rules and regulations vary from country to country, to name a few. Strategic decision making in GSCs at the exclusion of infrastructure enterprises, governance organisations and their surroundings is becoming analytically and operationally, untenable. We are proposing a new, holistic, complex GSC perspective (see Figure 1).

3 GSCs – theories, management, inclusiveness

Beginning with Forrester's classic essay on distribution theory in 1958, GSC management theory, as do all management concepts, has experienced a dynamic evolutionary process, transitioning through various stages of maturation, often in very short periods of time which will most likely continue for some time (Tan, 2001). GSC literature has transitioned from a logistics perspective, to supply chains, and now to GSCs, with increasing interest in strategic management overlays. These dynamic innovations in supply chain operations and management were spurred by new information technologies, such as 3PL software enhancing strategic GSC decision making, upstream and downstream – including agents from all three layers, a holistic mind-set (Neace, 2008). In their review, Melnyk and colleagues (2006) found SCM literature had transitioned from order-oriented, cost-driven and execution-focused to being strategically focused, demand-oriented, dynamic and driven by multiple objectives. There is no one unifying *theory* of SCM and this is also true of GSCM. Maybe more so, because of GSCs diversities and longer and more complex value streams (Halldorsson et al., 2007). They also become more vulnerable to risks – internal, external, natural and man-made disasters (Kleindorfer and Saad, 2005; Svensson, 2000; Humphrey, 2003).

Globalisation's dramatic growth and its impact across a broad range of business decision making levels – micro to macro – present supply chain managers of all three layers very interesting challenges. Today's world is flat; consumers evermore empowered; markets evermore competitive and dynamic; supply chains increasingly networked, shifting from command and control to cooperation and collaboration to demand driven (Friedman, 2005). Management of these challenges is at the core of effective GSCM. The following discussion puts them into six groupings: holism, strategy and systems, technology, exogenous factors, e-commerce (Manuj and Mentzer, 2008; Simchi-Levi et al., 2003; Wagner and Bode, 2009) and surroundings – such as the ecologies and the cultures GSCs flow through. GSC literature is not this discrete and there is significant overlap and intertwining among the classifications. Essentially, all literature reviewed was multidisciplinary and multifunctional in its presentations, but the thrust of threads were not hard to distinguish even with significant overlap and intertwining.

3.1 *Holism*

This concept is based on a metaphor of live organisms in relation to economic systems interacting with their surroundings (Von Bertalanffy, 1968, 1975). The majority of writers we reviewed were holistic in their perspective either directly or indirectly. Indeed, holism derives from the evolution of management theory from early Taylorism through behavioural approaches until, nowadays, contingency theory, where holistic reasoning is an axiomatic assumption (Jones and George, 2003). Scholars as early as Forrester (1958) noted that supply chains should be strategically thought of as integrated systems. Today holistic integration is one of several dominant themes in GSC/SCM literature, challenging management from all three layers to adjust their corporate/enterprise/organisational 'silo' mindsets. Writers, all 'viewing' GSCs from different perspectives whether discussing primary players; infrastructure or governance, came to the same conclusions – holistic GSCs are essential to accomplish and attain strategic goals (Bukary, 2010; Hesse and Rodrique, 2009; Thomas and Griffin, 1996;

Walker et al., 2008). There is no disagreement with these writers holistic perspective for strategic development. What we found missing were exclusions of layers two, three and their surroundings: hard and soft infrastructure; governance organisations, and the many tertiary organisations and environments that impact strategic decision-making in GSCM. Gospodarek (2010) developed an e-business model where holistic GSC structures are layered, interacting information systems.

3.2 Strategy and systems

Dynamic systems are continually changing. Many authors writing on this subject encouraged supply chain managers to engage in multi-firm strategic planning within their respective GSCs: such as more responsive supply chains (Gunasekaran et al., 2008) as consumer/users are evermore empowered; primary partners change and evolve over time requiring relationship compatibility adjustments (Manuj and Mentzer, 2008); cross-organisational and information system design/development (Chan et al., 2003; Lee, 2000; Mason-Jones and Towill, 1997); infrastructure integration – ports, ships, freight hubs (Panayides and Don-Wook 2009; Rahimi et al., 2008); use of supply chain metrics for integrating supply chains and health delivery systems (Li and Simchi-Levi, 2009; Chick et al., 2006); and governance organisations, such as practise guides (Battles, 2008). The many gains to be achieved through holistic strategy planning and systems integration can only occur if there is significant information sharing among all relevant chain members (Baihaqi et al., 2008). Information sharing, even with its attendant risks, is important to attain greater and higher levels of coordination, alignment and collaboration, (Knowledge-Wharton, 2006; Lee and Whang, 2000) underpinned by layers of trust. Strategic GSC networks are built on trust (Cheung and Myers, 2008). Barrett (2011) uses the phrase, ‘orchestration’ to emphasise the necessity for integrated blending of SCM strategic planning. Some brands whose reputations are on-the-line daily in the market place increasingly find GSC managers asserting their roles as supply chain orchestrators (McBeath 2011), the integration of supply-demand management planning efforts at all levels. What is missing is inclusion of layers two, three and the surroundings.

Some writers believe risk analysis identification is a precursor to effective strategic planning. Muthukrishnan and Shulman (2006) found in their global survey of supply chain executives the most significant risk was availability, cost and quality of labour. There were many others. Concerning strategy and systems, we believe, regardless of category source, primary players, infrastructure enterprises, governance organisations, or surrounding tertiary entities, integration of GSC strategy is not only important but inevitable for success (see Figure 1).

3.3 Technology

It is ubiquitous. Our literature search could not escape its pervasiveness. Members of GSCs are deeply involved in its development and implementation: from design, to processes, to tracking and reporting, to simulation and modelling to communications. We found this to be true in our research/observations of peoples and places in all four areas. Much of this activity crosses organisational and often political boundaries vertically and horizontally, including participants from all four categories, especially governance and R&D firms (Bunker and Ciccantell, 2005). Technology has spurred several of the most recent global industries – 3PL (Power et al., 2007), mobile gadgets and their apps

(Kumar, 2004), and contributed greatly to making the world flat – just as much as ‘cheap’ labour.

Technology and globalisation literature has shifted dramatically in this century. In the ‘90s writers focused on macro subjects: for example, discussing and debating how outsourcing, governance support, and IT were parallel partners. In this decade, emphasis has shifted to a micro perspective, discussing applications of technology innovations such as simulation (Zeng and Yang, 2009), optimisation (Mele et al., 2005), decision support systems – DSS (Meixell and Gargeya, 2005), RFID (Simchi-Levi, 2005) and decision-making under uncertainty through contingency theory and ‘fuzzy’ logic (Jones and George, 2003; Liu, 2007; Stonebraker and Afifi, 2004). Through globalisation of IT, spatial and temporal issues such as time zones, language miscues, multi-cultural difficulties and surroundings awareness are now being addressed.

Bringing internet facilitators and software designers aboard as primary and infrastructure members of GSCs has led to significant improvements in performance: less inventory in the channel, shorter response times to customer demands and exogenous events, and greater integration, coordination and collaboration both internally and externally (Bowman, 2001; Digenova, 2001). Results are improved productivity and profitability when operations run smoothly.

3.4 Exogenous factors

There are three broad categories of exogenous events that impact GSCs: those generated by Mother Nature (hurricanes, earth quakes, flooding, etc.); man-made (terrorism, infrastructure shutdowns and governance disruptions such as worker strikes); and pandemics (infectious diseases – HIV-Aids, cholera). Literature reviewed came from a broad range of disciplines and was wide in its scope of coverage – local to global , for example, the US Government sponsors a voluntary programme, Customs-Trade Partnership Against Terrorism (C-TPAT) that encourages and strengthens international supply chains and US border security (C-TPAT, n.d.). Many writers noted exogenous events were unpredictable, such as violent weather that disrupt communities and GSCs and dock workers strikes, shutting down ports causing serious disruptions of GSCs and significant economic consequences in communities where these events take place (Hookway and Poon, 2011; Altay and Ramirez, 2010; Farris, 2008; Vakharia and Yenipazarli, 2008). Some writers saw particular exogenous events as long term, such as global warming and air pollution (Cannon, 2008), in some cases caused by energy consumption; triggering, today, many global firms to seriously assess their ‘carbon footprint’ (Hertwich and Peters, 2009). Consequences of pandemics, such as influenza (Duncan, 2006), and long term impacts of environmental degradation on food supply chains (Jones, 2002) requires GSC managers of all three layers to interact with hosts of national and local organisations from their surroundings, not integral members of their GSCs; but all necessary to sustain economic flows. All literature we reviewed in this area was multi-disciplinary and inclusive of organisations from all four areas. There were many contributions from writers and organisations representing NGOs of all stripes: unions, the medical field, military, religion, labour and governments at all levels. For example, International Labor Organisation, representing labour and the International Finance Corporation of the WTO representing both global and local manufacturers, sponsoring joint programs to improve local labour well-being and working conditions in underdeveloped counties – better work (ILO, 2006).

Though often unpredictable as to when particular exogenous events may occur (micro), several writers noted such events do occur at some point in time (macro), proposing that GSCs and the communities they flow through should be prepared to mitigate such disruptions: such as hurricanes (Hookway and Poon, 2011; Van Wassenhove, 2006). Van Wassenhove believes humanitarian organisations and GSCs have similar characteristics: the need for appropriate preparedness, cooperation and collaboration, a holistic overlay, necessary to buffer impacts of disasters and disruptions when they occur. Altay and Ramirez (2010) found that natural disasters were not all alike and strategic preparatory planning should be disaster-location specific, involving all relevant stakeholders to be effective – not an ‘all-hazard’ strategy. Additionally, they found organisations upstream tend to benefit from disasters while those organisations downstream sustained the brunt of the damage. Further discussion of this issue is in the section – surroundings.

Other writers found many long-term exogenous events can be forecast with reasonable degrees of accuracy and their consequences measured; such as the impact of HIV-Aids (BSR, n.d.) and carbon emissions (Hertwich and Peters, 2009; Jones, 2002), or the continual erosion of jobs in developed countries to emerging economies (Blinder, 2006). Disaster impacts can be buffered and mitigated through ‘holistic’ planning inclusive of all relevant stakeholders (Altay and Ramirez, 2010). Many made the case that preparation, prevention and education would save lives, save property and lessen value chain disruptions (Craighead, 2010). There was consensus among writers regarding responses to exogenous events: effective planning required a holistic approach including not only GSC members from the primary level but the other two levels plus an array of stakeholders from beyond a particular GSC to adequately prevent, buffer and respond to these calamities. Holistic, cooperative, collaborative preventative programs can be developed and risks managed even in complex systems such as GSCs (Wagner and Bode, 2009).

3.5 E-commerce

E-commerce and its underpinning web/internet on GSCs is immeasurable, so says the literature we reviewed (e.g., Simchi-Levi et al., 2003), permeating every aspect of GSC activities. IT technology is a major driving force of globalisation, with supply chains getting longer, leaner and more complex (Gospodarek, 2010). Because of e-commerce’s technological significance and its economic impact across borders it also has political and trade policy consequences (Tan and Ouyang 2004). The more globally oriented an enterprise the more likely they use e-commerce (Poh-Kam and Yuen-Ping, 2004). E-commerce has been adopted by growing numbers of infrastructure organisations, such as ports, import/export brokers, transport companies and entire communities that blend their communications among the various users including tertiary organisations from surrounding logistics hubs, such as emergency medical facilities, FEMA, and government security organisations, enabling connecting the ‘dots’ for seamless flows of information across most entities of GSCs and their surroundings (Gallager, 2001). Obviously, government organisations at all levels are using ever higher levels of technology to prevent and mitigate security issues and these include major elements of GSCs (CACI, 2010). Internet and e-commerce has fostered an enormous global industry of specialist organisations which spurs innovation and will likely continue for some time with many

of these specialist firms transitioning from fringe organisations to primary players over time (Krishnan, n.d.).

3.6 *Surroundings*

All GSCs consists of a series of nodes and processes that, when operating appropriately, create flows of value. These nodes, these hubs, these flows do not occur in a vacuum. They happen in *surroundings* (see Figure 1), the interactions and boundaries that characterise environments, the milieu of GSCs. Surroundings have boundaries, therefore GSCs flow through a series of sequential surrounding as products, services, information and monies move back and forth from origin to final destination (Neace, 2008).

Surroundings consist of a wide variety of entities and tertiary conditions and can have major effects on all aspects of GSCs flows: hard infrastructure (e.g., road, bridges, tunnels, river ways, canals, etc.) (DeAngelis, 2011; Bowman, 2011); dependable supplies of energy and water (BSI, n.d.); business climates of surroundings – history of supportive or non-supportive communities (Johnson, 2002); quality of and availability of education and labour (Wang, 2009; OhUallachain and Satterthwaite, 1992); community stability and social well-being (Love and Crampton, 1999); and weather patterns (Shister, 2011).

These and other surround factors can be very significant, especially for GSC managers when assessing various community surroundings for location of SCM facilities and operations. Criticality of selected elements in a surrounding's area of coverage plays key roles in location decisions and strategic planning (Wang, 2009).

3.7 *Summary of findings from literature search*

- SCM and GSCM analysis often supersedes any single firm analysis in GSCs
- challenges faced by GSCs are both immediate, long term and not evenly spread across the spectrum of GSCs
- information sources came from a broad array of disciplines, well beyond traditional SCM literature
- the web has become a primary source of information in GSCM strategic development
- increasing numbers of websites, blogs and newsletters are dedicated to SCM/GSCM
- all 3PL providers and consulting organisations have websites with blogs, newsletters focused on GSC issues
- writers reviewed for this study maintained a 'primary' player focus with limited mention or discussion of infrastructure enterprises, governance organisations with scant discussion of surroundings
- the exception was 'exogenous events' – where many writers recognised the need for holistic planning, including all three layers, plus tertiary entities of surroundings, as shown in Figure 1
- although many writers referred to the need for 'holistic', integrated, strategic planning, they limited this window to primary players in the majority of the writings we reviewed.

A 'holistic' model of GSCs is presented, discussed and we make manifest the need for recognition and inclusion of infrastructure enterprises, organisation governance entities with primary players and community surroundings to achieve holistic, integrated strategic planning across GSC spectrums. Our model recognises this orchestration of relationships between layers and their many boundary surroundings which act as interlayer bonds, as suggested by Gospodarek (2009) and Scott (1981) in complex, dynamic environments – as GSCs are.

4 Holistic GSC model: shifting the paradigm

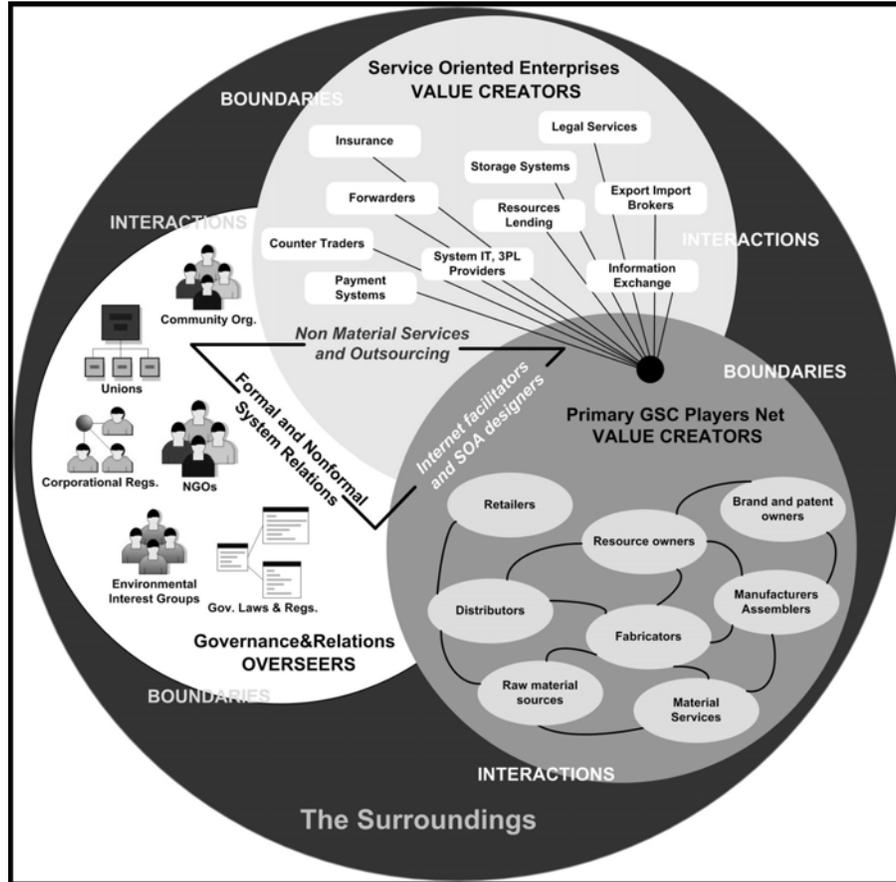
Figure 1 is a conceptual model. It does not propose to represent any one GSC system. It, generically, identifies readily noted primary players, infrastructure enterprises, governance organisations and entities and tertiary conditions of their surroundings. Each analyst/researcher can and should adapt the model to their particular needs/situation. Ignoring implied interconnectedness among the many nodes and processes throughout GSCs, as implied in Figure 1, results in increasing costs and decreased competitiveness. Developing collaboration and trust among all major elements of GSCs is essential and always ongoing for network development (Castells, 2000). Creation of integrated multi-agent GSC networks – seamless value streams from source to user – is the major task of GSC managers (Zolin et al., 2004; Bowman 2004). In Figure 1 we shift the traditional model that emphasises primary players to one including a host of additional elements discussed above – a paradigm shift toward complex holism.

Infrastructure enterprises and governance organisations, when meaningfully integrated into GSCs have very positive impacts, creating system synergy, creating structural holes, or at minimum, dampening impacts of negative exogenous events when they occur (Burt, 1992; Granovetter, 1973). These multi-agent operatives and their surroundings must continually adapt as GSC networks evolve or they break down (Holland and Miller, 1991). For example, the US Coast Guard routinely inspects manifests of incoming container ships to all ports in the USA. Upon finding a suspicious manifest or packing document that does not meet security and environmental standards they can and do stop ships, preventing and or delaying their arrival in port (Frittelli, 2005). Such actions stop not one or several containers but every container on that ship, which could be into the thousands, from reaching destinations on time. This also includes counter-groups of governance organisations in other connected countries engaged in similar tasks.

Figure 1 suggests a variety of multi-agent relationships among primary players, infrastructure enterprises, governance organisations and their many boundaries, interacting surroundings. Discussions with a variety of GSC operatives from all four areas, including shippers, import-export brokers, transport carriers (land and sea), port operators, government inspectors/security agents (USDA, Homeland Security) and specialised service providers (tug boat operators, foreign exchange dealers, 3PL providers and counter-trade agents) at some of the world's major seaports (Hong Kong, Rotterdam, Savannah and Singapore), strongly supports information sharing and collaboration among these parties and using virtual communications where feasible. These agents serve as catalysts for interconnecting, maintaining and sustaining supply chain systems and flows. Present day writers overlook two of the three layers, except for exogenous events, and are

silent regarding surroundings. This is a shortcoming in the literature. Our Figure 1 remedies this issue.

Figure 1 Global supply system paradigm – holistic, multi-layered and intertwined



All participants in GSCM can use Figure 1 as a working holistic model to develop and analyse the full scope and significance of relationships in their GSCs. It can be used to determine where along the value chain which infrastructure and governance agents should be consulted and involved during strategic planning development. Indeed, successful GSC managers involve various agents and specialist organisations, both internal and external for new product development (Handfield et al., 1999) and information network development. This requires holistic thinking, developing cooperation, coordination, collaboration and alignment up and down dynamic, complex value streams for effective GSC management in today’s competitive world (Neace, 2008; Kanakamedala et al., 2003). Figure 1 strongly proposes a dynamic, more complex, ever-changing and inclusive GSC environment – a shift in the GSC paradigm.

5 Conclusions

To optimise flows of GSCs, management will have to harness and synchronise its many flows (Kim, 2006) using open, adaptable structures that blend and evolve as circumstances dictate. Global supply systems are living examples of contingency theory at work. This leads to the adoption of holistic concepts. Critical will be managements' abilities to develop collaboration and trust (Zolin et al., 2004) in diverse, evolving, fuzzy environments of different cultures, languages (Whitman and Panetto, 2006), time zones and ever-evolving rules, regulations and politics. Inter-organisation collaboration to maintain and sustain networked flows is inevitable. Staying on top of issues and challenges internal to GSCs, management must also contend with exogenous events through holistic risk assessment. GSC managers should be prepared with contingency plans in place throughout their networks to react positively when such happenstances occur (Guide et al., 2003). A holistic paradigm of GSCs (Figure 1) has potential to enhance value creation seamlessly throughout the multiplicity of networked levels that characterise GSC flows. This paradigm shift should be reflected in SCM and GSCM literature.

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