Developing a dynamic capabilities approach to risk mitigation strategies driven by water scarcity

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Abstract

Water stress mitigation has become a new business imperative evidenced by both institutional and practice communities.

In this context, the academic community has suggested that the "identification, assessment and management of water-related risks have emerged as major concerns for companies" (p.1019 Aivazidou et al., 2016). Leading corporations understand that natural resource scarcity has become "a critical supply chain risk factor" (p.158, Bell et al., 2012) and that firms should incorporate sustainable water management programmes into their corporate social responsibility and environmental management agenda (Aivazidou et al., 2016). This research develops an integrated dynamic network capability framework for water scarcity risk mitigation.

Keywords: Sustainable Supply Network Capabilities, Sustainable Dynamic Supply Network Capabilities, Water Scarcity

Introduction

The notion of water stress risks has become a crucial element in the development of corporate strategy. This observation is supported by both institutional and practice communities; in 2020 the WBCSD estimates more than three-quarters of businesses (78%) will be impacted by water scarcity, whilst PWC has suggested as early as 2012 that more than 60% of CEO's regarded water scarcity as an "important" or "very important" issue in their business operations (based on 141 CEO respondents).

In this stance, the academic community have also suggested that the "identification, assessment and management of water-related risks have emerged as major concerns for companies" (p.1019 Aivazidou et al., 2016). Leading corporations understand that natural resource scarcity (NRS) has become a "critical supply chain (SC) risk factor for the foreseeable future" (p.158, Bell et al., 2012) and that firms should incorporate sustainable water management programmes into their corporate social responsibility and environmental management agendas (Aivazidou et al., 2016). Evidently, resource scarcity mitigation capabilities in SCs present a nascent area of research.

Methodology

The definition of “capabilities” originates from the Ricardian perspective on rent creation and the Schumpeterian perspective of capability building (Vanpoucke et al., 2014; Srai et al., 2009). The term was further developed through the resource-based view theory, where capabilities were described as “tangible or intangible processes that are firm specific and are developed over time” (Srai et al., 2013, p.595). Morash (2001) suggests that SC capabilities present one of the building blocks connecting business strategy and SC strategy that lead to supply chain performance development.

Recently there has been a growing interest in sustainable supply network design with emphasis on addressing social, economic, and ecological effects on the business environment. In order to adjust to this constantly changing corporate environment firms develop dynamic capabilities that lead to long or short term sustainable competitive advantages (Beske et al., 2014; Lee et al., 2014). This refers to strategic routine, process, and product developments and new supplier integration practice developments in order to adapt to changes in the market (Teece, 2007; Teece at al., 1997; Danneels, 2011; Brusset and Teller, 2016; Vanpoucke et al., 2014).

A number of studies in the SC sustainability literature domain have been focused on static capabilities and dynamic capabilities (Liu et al., 2016; Beske et al., 2014, Brusset and Teller, 2017, Defee and Fugate, 2010; Tseng et al., 2016; Bell et al., 2012; Closs et al., 2011). However, the only attempt to classify a broad array of sustainable dynamic capabilities was made in the study by Srai et al. (2013). The work suggests SC ecological effects are eliminated through energy and resource efficiencies and waste minimisation. Here SC dynamic capabilities are presented in five major clusters, namely:

- *Sustainable supply network (SN) strategic design* capability results in structure, complexity, location, SN dispersion, level of SC integration (Eskandarpour et al., 2015; Pishvaee et al., 2014)
- *Network connectivity* cluster is presented by the operational connectedness of upstream and downstream SN actors, which includes supplier selection, supplier collaboration (joint work on environmental planning) and integration, supplier development (Pagell and Wu, 2009; Vacchon and Klassen, 2008; Srai et al., 2012)
- *Network efficiency* presents an ability to efficiently measure environmental impacts, to reduce resource consumption, and to discover and implement new production technologies in order to minimise impacts of production processes (Srivastava, 2007).
- *Network process development and reporting* refers to the process of measuring, reporting, and disclosing the firm’s progress towards their sustainable development goal to internal and external shareholders (Srai et al., 2012). Environmental reporting conventionally includes elements of environmental impact, resource utilisation, resource efficiency, resource consumption, and emissions.
- *Product/service enhancement* in a sustainability context brings innovation components through R&D into a product design and technology application in order to reduce reliance on scarce resources and materials (Srai et al., 2012).

The considered SC capabilities are mainly rooted to a resource-based-view that does not take into account natural recourse scarcity (NRS) aspects, which in turn has a direct impact on both firm business strategy and SC strategy. NRS presents “a critical SC risk factor for the foreseeable future” (p.158 Bell et al., 2012). As such integration of SC capabilities into SC strategy will lead to the achievement of higher resilience from natural resource scarcity.

An early attempt to bridge this gap was made in a study by Bell et al., (2012) in which resource scarcity issues in SCs were analysed through the prism of SC strategies. NRS mitigation approaches were divided into two major blocks - resource employment and conservation approaches.

Adopting Bell et al., (2012) NRS SC strategies typology this research makes a distinction between three major NRS approaches, namely:

- *Resource allocation strategy* is employed to allow building flexibility when designing a product and related processes, and choosing a site's current or future location. This strategy is built upon Bell et al. (2012) resource employment approach. This strategy is utilised to allow an identification of where and how resources are used in terms of physical site location and the resources required for product manufacturing.
- *Resource sustainment strategy* is employed to secure and support NRS availability and sufficient resource quality. These strategies include resource conservation approaches together with value chain integration.
- *Resource utilisation strategy* is employed to provide efficient and effective use of the resources at the site level and through the whole value chain.

Based on existing dynamic capability models in the sustainable SN domain (Srai et al., 2013; Liu et al., 2016; Brusset & Teller, 2017) to include dimensions of sustainability for scarce resource utilisation (Bell et al., 2012) this study proposes a dynamic capabilities framework (Figure 1) to mitigate water scarcity risks. The emerging framework methodology is rooted to the process operations capability model, developed by Srai at al., 2013, where sustainable capabilities classification is based on five main pillars, and SC strategies for NRS mitigation by Bell et al., 2012. This research extends these studies into the water resource scarcity field. We argue that the scarcity of natural resources affects SN configuration and can inform risk mitigation strategies. However, the water scarcity phenomenon is complex, thus companies' operational capabilities for water stress mitigation must be considered together with their dynamic capabilities, enabling strategic SC enhancement (Brusset and Teller, 2016), in order to respond to future changes in water availability.

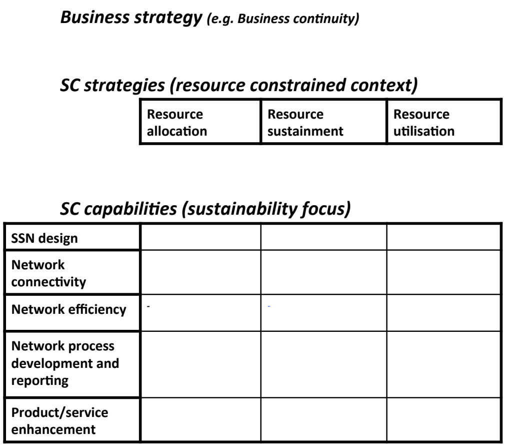

Figure 1 - NRS mitigation capabilities framework

In order to explore the feasibility of the approach it was necessary to operationalise the framework (Figure 1), by identifying through an extensive literature review, the water scarcity mitigation capabilities and dynamic mitigation capabilities dimensions that might be used in a case study examination. The resulting framework for water stress mitigation capabilities and dynamic capabilities, set out in Table 1 below, was then tested through two case studies. Results from these case studies, using the refined framework, are presented later in this paper followed by discussion and conclusions.

Literature review

The study employs an extensive literature review process of two major literature domains: NRS and sustainable SN.

Population growth as well as increases in income influence current consumption patterns leading to NRS in a number of areas in the world (Bell et al., 2012). Water scarcity, in this context, presents one of the "greatest global sustainability challenges" (Muller et al., 2015, p.30). Recent evidence suggests an increasing level of competition over water between agriculture, industries, and local communities (FAO, 2000, Pimentel et al., 2004). Indeed agricultural and industrial activities are closely linked to water consumption in their operations and directly influenced by water availability. According to statistics, the agricultural sector accounts for around 70% of total freshwater resources used today (UN Water, 2009). That leaves 22% of global fresh water used by the industrial sector (UN Water, 2009). However, distribution of water resources is not equal around the globe. The situation becomes even more complicated due to climatic factors (Yatskovskaya et al., 2016; Millner and Dietz, 2015). As such it is projected that more than 40% of the worlds population will be experiencing severe water stress by 2050 (UN Water, 2014). Companies operating in such environments are at risk of operations disruption, constraints to growth, and even loss of business.

In order to operate in natural resource constrained environments firms are forced to develop SC NRS mitigation strategies with subsequent mitigation capabilities. For example, commonly employed "static" capabilities include: water reduction, water reuse, water recycling, reclamation, recovery, participation in water efficiency and water conservation programmes, sustainable water disposal, and emissions management (Srai et al., 2013; Closs et al., 2011, Sarni, 2011). These capabilities are identified for a *resource sustainment* strategy in a *network efficiency* cluster due to their characteristics that are focused on the impacts of production process minimisation (Srai et al., 2013) and that support water resource availability with a sufficient quality level. While dynamic capabilities includes capital investment in technology for water stress elimination, water consumption reduction, and water neutral approach adoption, implying that all fresh water is captured and recycled (Closs et al., 2011; Hoekstra, 2008; Babin and Nikholson, 2011; Kleindorfer et al., 2005). Such allocation of the dynamic capabilities is proposed due to the forward-looking nature of these capabilities for resource availability sustainment.

The sustainable supply network design cluster driven by a *resource allocation strategy*, on the other hand, results in water scarcity SC redundancy and flexibility building through close collaboration with suppliers and regulators (Brusset and Teller, 2016) and investments in water offsetting (Sarni, 2011). The selection of these capabilities coupled with the characteristics proposed for this cluster results in SC dispersion and location and SC integration. The dynamic capabilities presented in this cluster are defined by strategic anticipation of resource availability change and resource allocation responses, such as strategic sourcing, relocation of SC nodes, SC allocation (Closs et al., 2011; Bell et al., 2012).

An example of *network connectivity cluster* capabilities, under a *resource utilisation strategy,* is illustrated through the development of key performance indicators for resource use, and sustainability governance through water stewardship standards for key suppliers (Beske, 2012; Bell et al., 2012; Pagell and Shevchenko, 2014). Network connectivity capabilities, using a resource utilisation strategy, provide inter/intra-firm effective and efficient use of water by means of upstream and downstream SC stakeholder engagement. Dynamic capability is a corporate indicator that exceeds the standards of fresh water intake and wastewater discharge (Reefke et al., 2010).

An example of *network process development and reporting* within the *resource sustainment strategy cluster,* includes water minimisation through new process implementation, recycling as a part of product/service design, the education, training, and development of employees on water utilisation, on-going training, and supplier training programmes on water resource minimisation and utilisation (Tseng et al., 2016; Zhu et al., 2004; Closs et al., 2011; Beske et al., 2014; Golinska and Kuebler, 2014; Babin and Nicholson, 2011; Kurnia et al., 2014; Sarshar et al., 1999). The allocation of such capabilities in this cluster is motivated by the development of network processes that can influence current and long run resource availability sustainment. Dynamic capabilities refer to a work place design that leads to minimisation of water consumption (Golinska and Kuebler, 2014; Bell et al., 2012; Kleindorfer et al., 2005).

A proposed framework (Figure 1) is further populated with water scarcity mitigation capabilities derived from the literature review (see Table 1).

Table 1- Water scarcity mitigation capabilities framework

NRS mitigation strategies / SC capability clusters	Resource allocation	Resource sustainment	Resource utilisation
SSN design	- Building redundancy and flexibility (suppliers, regulations) - Investment in water offsetting - Strategic sourcing - Relocation - Allocation	- Water assessment tools employment: WWF/WRI; Environmental clarity; Ecoinvent; LCA) - Water reduction technology tracking - Customise the tool /new tool development for water availability estimation - Corporate water stewardship standard development - Integration of manufacturing site mitigation polices - Understand and adopt global sustainability standards - Change in technology tracking - Innovation management	- Close-loop SC design - Corporate water management practice introduction - Water use efficiency for plant integration - Strategically integrate sustainability strategy into SC process (sustainable manufacturing processes) - Strategically integrate sustainability strategy into project management - Corporate water policies and management systems - CSR programme integration
Network connectivity	- Effective and efficient sharing - Flexibility of changing suppliers - Investment in water offsetting programmes for watershed	- Collaboration with value chain partners: water stewardship - Collaboration with value chain partners for reduction of raw material consumption - Integration of water assessment beyond manufacturing site but for some "hot-spot" suppliers - Tighter integration of suppliers for water management improvement - Cross-functional team installations for water stress risk mitigation - Business continuity planning with the firm and SC - Actionable supplier training programmes	- CSR programmes for resource management - Key indicator development for suppliers - Sustainability governance through water stewardship standards for key suppliers - Sustainability image development - Corporate indicator development exceeding the standards of water intake / wastewater discharge
Network efficiency	- Ability to map risks: direct and indirect - Production disruption minimisation through substitution of the resource supplier - Capital investment in infrastructure leading to water minimisation - Anticipation of future water stress and mitigation strategy development	- Improved tools for water management processes - Water efficiency programme participation - Conservation programmes - Shift from intra-firm to inter-firm resource management - Resource recovery, recharge, reuse, reclamation - Water disposal and recycling - Emissions management - Verification and assurance of disclosed info. with partnering organisations e.g. WWF, WRI - Water neutral (all fresh water captured and recycled) - Capital investments in technology	- Risk management - Water footprint: direct and supply chains - Ability to assess water risks and opportunities - Lean manufacturing processes - Substitution/avoidance of the resource
Network process development and reporting	- Minimisation of water via process design	- Water minimisation through new process implementation - Recycling/Reuse as a part of product/service design - Training and development of employees on water utilisation - Supplier training programmes on water resource minimisation and utilisation - Work place design to minimise water consumption	- Sustainable operations management - Product and process traceability - Visibility of suppliers' manufacturing operations - Regulatory compliance - Integration of reporting programmes (e.g., GRI, CDP) - Ability to meet regulatory and taxation changes
Product/ service enhancement	- Integration of environmental sustainability into product design/ regulation requirements	- Production process redesign - Material efficiency - Reduction of product environmental impact via informed material selection - *Innovative processes for product manufacturing* - *Ecodesign*	- Material substitution - Greener product design - Sustainable product design

Red – dynamic capabilities

Framework Application - Results from Exploratory Case Studies

In order to develop and refine the water scarcity mitigation capabilities framework, two exploratory case studies of two products (a pharmaceutical drug and a food supplement) were conducted. Selection of the cases was determined by multinational firm selections where there is increased interest in tackling water scarcity problems in its operations around the world. Conventionally, food, beverage, and semiconductor industries are associated with the development of water scarcity alleviation strategies due to their high water intensity (Sarni, 2011). However, selected case studies show that other sectors have also become increasingly affected by water scarcity problems. The data was obtained through semi-structured interviews and secondary sources, including company reports, news sources, and sustainability reports. Examples of water stress mitigation strategies for each product are further discussed.

Food supplement The food supplement product is mainly manufactured in areas that are highly affected by water stress. Historically manufacturing locations of this product were driven by proximity to markets. Most of the plants' facilities and manufacturing equipment are specified according to out-dated designs. However, the company's intention to bring new technologies to these regions in order to minimise water consumption is often hindered by regulatory restrictions. Regulators in these regions are lacking centralised NRS mitigation policies, meaning that the company must be flexible with regard to regulatory burdens. Moreover, the company develops initiatives to engage community, policy, and other stakeholders operating in these regions in joint efforts towards water scarcity mitigation.

Pharmaceutical product Drug product manufacturing sites, on the other hand, are located in areas less affected by water scarcity. The decision to locate production operations in these regions was partially driven by resource availability and only a few sites were set up in areas of NRS that are highly regulated and which has resulted in increased water rates. Key raw material suppliers tend to be located in regions of NRS and the company usually works together with suppliers to mitigate NRS. Observed data illustrates that some of the firm's manufacturing sites and primary and secondary suppliers have been experiencing problems with raw materials and product supply. Most of the water consumption in the pharmaceutical industry is concentrated in raw materials. Here suppliers, sometimes even farmers, are lacking visibility of the local NRS situation and water scarcity mitigation practices, which in turn brings pressure to the manufacturing organisation. Thus, the firm develops assessment programmes that help key raw material suppliers to evaluate their operations affected by water stress and develops continuous improvement strategies. Under resource sustainment strategies the company continuously seeks possible alternative water minimisation solutions, e.g., the development of water neutral processes. Recently the company has introduced water filtering and leak monitoring programmes to their sites.

Integrating findings across the two exploratory case studies, from the perspective of observed water stress mitigation capabilities, Table 2 captures further development of the proposed framework by setting out capabilities that concur with those identified in the literature, and those newly observed organisational routines from both a mitigation and dynamic capability perspective.

Discussion and Conclusions

Water scarcity mitigation capabilities in SC is an emerging area of SC research. This is supported by an extensive literature review process as well as through case studies. This paper makes an attempt to bridge the gap in the SN capability model literature by adapting strategies for NRS mitigation (Bell et al., 2012). The proposed framework is built upon two literature domains. NRS, which emphasises the importance of sustaining resource availability to meet growing demand from a long-run perspective (Yatskovskaya et al., 2016), incorporates SC capability theory emphasising new process development to sustain long and short term competitive advantages along with SC

Table 2 – Case Study enriched water scarcity mitigation capabilities framework

NRS mitigation strategies / SC capability clusters	Resource allocation	Resource sustainment	Resource utilisation
SSN design	**- Building redundancy and flexibility (suppliers, regulations)** - Investment in water offsetting **- Outsourcing of manufacturing operations** - Strategic sourcing - Relocation - Allocation	**- Water assessment tool employment: WWF/WRI; Environmental clarity, EcoInvent; LCA)** **- Water reduction technology tracking** **- Customised tool /new tool development for water availability estimation** **- Corporate water stewardship standard development** - Integration of manufacturing site mitigation polices - Understand and adopt global sustainability standards **- Change in technology tracking** - Innovation management	- Close-loop SC design - Understand and adopt global sustainability standards (e.g., Alliance for Water stewardship) - Corporate water management practice introduction **- Water use efficiency for plant integration** **- Strategically integrate sustainability strategy into SC process (sustainable manufacturing processes)** **- Strategically integrate sustainability strategy into project management** - Corporate water policies and management systems - CSR programme integration
Network connectivity	- Effective and efficient sharing **- Flexibility of changing suppliers (sometimes limited to contractual agreement)** - Investment in water offsetting programmes for watershed	**- Collaboration with value chain partners: water stewardship** - Collaboration with value chain partners for reduction of raw material consumption **- Integration of water assessment beyond manufacturing site but for some "hot-spot" suppliers** **- Tighter integration of suppliers for water management improvement** - Engagement with stakeholder/community/policy **- Cross-functional team installations for water stress risk mitigation** **- Business continuity planning with the firm and SC** - Actionable supplier training programmes	**- CSR programmes for resource management** **- Key indicator development for suppliers** - Supplier continuous improvement of water management - Sustainability governance through water stewardship standards for key suppliers - Sustainability image development - Corporate indicator development exceeding the standards of water intake/wastewater discharge
Network efficiency	**- Ability to map risks: direct and indirect** **- Production disruption minimisation through substitution of the resource supplier** - Anticipation of future water stress and mitigation strategy development - Capital investment in infrastructure leading to water minimisation	- Improved tools for water management processes **- Water efficiency programme participation** **- Conservation programmes** **- Shift from intra-firm to inter-firm resource management** **- Resource recovery, recharge, reuse, reclamation/**alternative water sources **- Water disposal and recycling/** filtering/leak monitoring **- Emissions management/** wastewater management (treatment/ reclamation) **- Verification and assurance of disclosed info. with partnering organisations e.g. WWF WRI** **- Water neutral (all fresh water captured and recycled)** **- Capital investments in technology**	**- Risk management** **- Water footprint: direct and supply chains** **- Ability to assess water risks and opportunities** - Lean manufacturing processes **- Substitution/avoidance of the resource**
Network process development and reporting	**- Minimisation of water via process design**	**- Water minimisation through new process implementation** **- Recycling/Reuse as a part of product/service design** **- Training and development of employees on water utilisation** **- Supplier training programmes on water resource minimisation and utilisation** **- Process water neutral** **- Work place design to minimise water consumption**	- Sustainable operations management - Constant monitoring of "hot-spot" sites **- Product and process traceability** - Visibility on suppliers' manufacturing operations **- Regulatory compliance** **- Integration of reporting programmes (e.g., GRI, CDP)** **- Ability to meet regulatory and taxation changes**
Product/ service enhancement	- Integration of environmental sustainability into product design / regulation requirements	**- Production process redesign** **- Material efficiency** - Reduction of product environmental impact via informed material selection - Innovative processes for product manufacturing - Ecodesign	**- Material substitution** - Greener product design **- Sustainable product design**

Bold – theory correlates with case study results, Red – dynamic capabilities, Blue – new capabilities derived from cases

performance development. The framework represents an integrated dynamic SN capability framework for water scarcity risk mitigation. Building on these theoretical developments and practical examples a water stress mitigation framework is proposed (suggesting that three main NRS mitigation strategies vary based on SN capability clusters) to help understand NRS problems and to identify SN responses to changing resource availability levels (Bell, et al., 2012). The case studies were employed to both enrich and test the approach of applying the proposed framework, recognising that further case study testing is necessary. Industries are increasingly realising the adverse effects of current water scarcity on their SCs and operation processes and are thus developing mitigation capabilities. The case studies illustrate that this company has its primary focus on resource sustainment and resource utilisation strategies that are mainly static. This shows that the firm's reactive approach to NRS affects the supply of raw materials and/or products, and can even result in a failure to maintain a continuity of production operations. For instance, approaches to responding only to "hot-spot" manufacturing sites and key suppliers does not promote the development of proactive approaches to NRS mitigation in regions that have only started gaining water scarcity concerns. The framework developed here introduces a novel approach by combining water scarcity mitigation static and dynamic capabilities to address current and potential effects of water scarcity to sustain business continuity.

References

Aivazidou, E., Tsolakis, N., Iakovou, E., Vlachos, D. (2016), "The emerging role of water footprint in supply chain management: a critical literature synthesis and a hierarchical decision-making framework", Journal of Cleaner Production, 137 pp. 1018–1037.

Babin, R. and Nikholson, B. (2011), How green is my outsourcer? Measuring sustainability in global IT outsoursing, An International Journal of Strategic Outsoursing, Vol. 4, No.1, pp. 47-66.

Bell, J.E., Autry, C.W., Mollenkopf, D.A. and Thornton, L.M. (2012), "A natural resource scarcity typology: theoretical foundations and strategic implications for supply chain management", *Journal of Business Logistics*, Vol. 33 No. 2, pp. 158-166.

Beske, P. (2012), "Dynamic capabilities and sustainable supply chain management, *International Journal of Physical Distribution & Logistics Management*, Vol.42, No.4, pp. 372-387.

Beske, P., Land, A., Seuring, S. (2014), "Sustainable supply management practices and dynamic capabilities in the food industry: A critical analysis of the literature", *International Journal of Production Economics*, Vol. 152, pp. 131-143.

Brusset, X., and Teller, C. (2017), "Supply chain capabilities, risks, and resilience", *International Journal of Production Economics*, Vol. 184, pp. 59–68.

Closs, D.J., Speier, C., and Meacham, N. (2011), "Sustainability to support end-to-end value chains: the role of supply chain management", *Journal of the Academy of Marketing Science*, Vol.39, Iss.1, pp. 101-116.

Danneels, E. (2011), "Trying to become a different type company: Dynamic capability at Smith Corona", *Journal of Strategic Management*, Vol. 32, Iss.1, pp.1-31.

Defee, C. C., and Fugate, B.S. (2010), "Changing perspective of capabilities in the dynamic supply chain era", *The International Journal of Logistics Management*, Vol.21, No. 2, pp.180-206.

Eskandarpour, M., Dejax P., Miemczyk, J., Peton O. (2015), "Sustainable supply chain network design: An optimization-oriented review", *Omega*, pp. 11-32.

FAO (2000), New Dimensions in Water Security: Society and Ecosystem Services in the 21st Century, available at: ftp://ftp.fao.org/agl/aglw/docs/misc25.pdf (accessed 25th April 2017).

Golinska, P. and Kuebler, F. (2014), "The method for assessment of the sustainability maturity in remanufacturing companies", In Proceedings of the 21st CIRP Conference on Life Cycle Engineering (CIR LCE), Trondheim, Norway, 18–20 June; Volume 15, pp. 201–206.

Hoekstra, A.Y. (2008), "*Water neutral: reducing and offsetting the impacts of water footprints"*, UNESCO-IHE Value of Water Research Report Series No. 28, Delft, The Netherlands.

Kleindorfer, P.R., Singhal, K., and Van Wassenhove, L.N. (2005), Sustainable Operations Management, *Production and Operations Management*, Vol. 14, Iss. 4, pp. 482-492.

Kurnia, S., Rahim, M. M., Samson, D., Prakash S. (2014), *"Sustainable supply chain management capability maturity: Framework development and initial evaluation"*, Proceedings of the European Conference on Information Systems (ECIS) 2014, Tel Aviv, Israel, June 9-11

Lee, K.L., Udin, Z.M., Hassan, M.G. (2014), "Global Supply Chain Capabilities in Malaysian Textile and Apparel Industry", *International Journal of Supply Chain Management*, Vol.3, No. 2, pp. 31- 40.

Liu, Y., Srai, J.S., Evans, S. (2016), "Environmental management: the role of supply chain capabilities in the auto sector", *Supply Chain Management: An International Journal*, Vol.21, Iss.1, pp.1-9.

Millner, A., and Dietz S. (2015), "Adaptation to climate change and economic growth in developing countries", Environment and Development Economics, Vol.20, Iss. 03, pp. 380-406.

Morash, E.A. (2001), "Supply Chain Strategies, Capabilities, and Performance", *Transportation Journal*, Vol. 41, No. 1, pp. 37-54).

Mueller, S.A., Carlile A., Bras B., Niemann T.A., Rokosz S.M., McKenzie H.L., Kim H.C., and Wallington T.J. (2015), "Requirements for water assessment tools: An automotive industry perspective", *Water Resources and Industry*, Vol.9, pp. 30-44.

Pagell, M. and Shevchenko, A. (2014), "Why Research in Sustainable Supply Chain Management Should Have no Future", *Journal of Supply Chain Management*, Vol. 50, Iss. 1, pp. 44-55.

Pagell, M., and Wu, Z. (2009), "Building a more complete theory of sustainable supply chain management using case studies of ten exemplars", *Journal of Supply Chain Management*, Vol. 45, Iss. 2, pp. 37-56.

Pimentel, D., Berger, B., Filiberto, D., Newton, M., Wolfe, B., Karabinakis, E., Clark, S., Poon, E., Abbett, E., Nandagopal, S. (2004), "Water Resources: Agricultural and Environmental Issues", *American Institute of Biological Sciences*, Vol. 54, Iss. 10, pp. 909 -918.

Pishvaee, M.S., Razmi, J., Torabi, S.A. (2014), "An accelerated Benders decomposition algorithm for sustainable supply chain network design under uncertainty: A case study of medical needle and syringe supply chain", *Transportation research*, Part E, Vol. 67, pp. 14-38.

PWC (2012), Rio+20 CEO and Citizens poll results, available at: http://www.pwc.es/es/sala-prensa/notas-prensa/2012/assets/pwc-rio-20-results.pdf (accessed 20th January 2017).

Reefke H., Sundaram D., Ahmed M.D. (2010), "Maturity Progression Model for Sustainable Supply Chains", *Advanced Manufacturing and Sustainable Logistics*, Lecture Notes in Business Information Processing, Vol 46. Springer, Berlin, Heidelberg.

Sarni, W. (2011), "Corporate Water Strategie", Earyhscan, New York, NY.

Sarshar M., Finnemore M., Haigh R., Goulding J. (1999), *"SPICE: Is a Capability Maturity Model applicable in the Construction Industry"*, Durability of Building Materials and Components 8, Pp. 2836-2843.

Srai, J.S., Alinaghian, L.S., Kirkwood, D.A. (2013), "Understanding sustainable supply network capabilities of multinationals: a capability maturity model approach", *Proc IMechE, Part B: J Engineering Manufacture*, Vol. 227, Iss.4, pp. 595–615.

Srai, J.S., (2009), Process Organisation, Capabilities and Supply Networks – Enterprise organization and operation, Capter 15.3 In Springer Handbook of Mechanical Engineering, Springer, Heidelberg, pp. 1279 – 1290.

Srivastava, S.K. (2007), "Green supply chain management: a state-of-art literature review", *International Journal of Management Review*, Vol. 9 Iss.1 pp. 53-80.

Teece, D.J. (2007), "Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance", Journal of Strategic Management, Vol. 28, pp. 1319-1350.

Teece, D. J., Pisano, G., Shuen, A. (1997), "Dynamic capabilities and strategic management", Strategic Management Journal, Vol.18, Iss.7, pp. 509-533.

Tseng, M.L., Tan, K., and Chiu, A.S.F. (2016), "Identifying the competitive determinants of firms' green supply chain capabilities under uncertainty", Clean Technologies and Environmental Policy, Vol. 18, Iss. 5, pp. 1247-1262.

UN Water (2009), Water, available at: http://www.unwater.org/downloads/Water_facts_and_trends.pdf, (accessed 25th April 2017).

Vacchon, S. and Klassen, R.D. (2008), "Environmental management and manufacturing performance: the role of collaboration in the supply chain", International Journal of Production Economics, Vol. 111, pp. 299-315.

Vanpoucke, E., Vereecke, A., Wetzels, M. (2014), Developing supplier integration capabilities for sustainable competitive advantage: A dynamic capabilities approach, Journal of Operations Management, Vol. 32, pp. 446-461.

WBCSD (2012), "Water for Business Initiatives guiding sustainable water management in the private sector", available at: http://www.bcsd.org.tw/sites/default/files/node/domain_tool/678.file.2161.pdf (accessed 20th January 2017).

Yatskovskaya, E., Srai, J., & Kumar, M. (2016), "Local water stress impacts on global supply chains: Network configuration and natural capital perspectives", *Journal of Advances in Management Research,* Vol.13, Iss. 3, pp. 368-391.

Zhu, Q., Sarkis, J., and Geng, Y. (2005), "Green supply chain management in China: pressures, practices and performance", *International Journal of Operations & Production Management*, Vol.25, No. 5, pp. 449-468.