IMPROVING SUPPLY CHAIN PERFORMANCE USING 'VUCA' DRIVERS

Dr. Khaled G. El-Sakty[1] and Engy Osama[2]
Arab Academy for Science & Technology, Cairo, Egypt;
North Carolina State University (NCSU), USA

ABSTRACT

Volatility, Uncertainty, Complexity and Ambiguity (VUCA) Drivers are increasingly used in recent years to describe the current business environment and the impact it has on the supply chain performance. The VUCA term became increasingly interesting to the leaders who seek to operate their businesses efficiently and effectively. Hence, the purpose of this paper is to investigate how VUCA can be applied by companies to improve their supply chain performance.

บทคัดย่อ

ในช่วงหลายปีมานี้ มีการนำเอาคำว่า VUCA ซึ่งเป็นตัวย่อของ แรงขับเคลื่อนจากความผันผวน ความไม่แน่นอน ความซับซ้อน และความคลุมเครือ มาใช้มากขึ้นเพื่อบรรยายสภาพแวดล้อมทางธุรกิจในปัจจุบันและผลกระทบของมันที่มีต่อผลปฏิบัติการโซ่อุปทาน คำว่า VUCA กลายเป็นที่สนใจของผู้นำองค์กรที่แสวงหาแนวทางบริหารธุรกิจ เพื่อให้เกิดประสิทธิภาพและประสิทธิผล บทความนี้จึงมีวัตถุประสงค์ เพื่อสืบค้นว่าบริษัทจะสามารถนำเอา VUCA ไปประยุกต์ใช้เพื่อปรับปรุงผลปฏิบัติการโซ่อุปทานได้อย่างไร

PURPOSE

The purpose of this paper is to explore the VUCA concept and discuss the relationship amongst the concept's four drivers (Volatility, Uncertainty, Complexity and Ambiguity) with the aim of understanding their significance and impact on supply chain performance. Also, the paper aims to discuss how companies can adopt proper strategies for coping with the inevitable effect of the VUCA drivers, in order to gain a competitive advantage by running the business both efficiently and effectively. Thus, this paper has sought to discuss the following problem: *How can VUCA be applied by companies to improve their supply chain performance?*

[1] The author is Associate Professor and Head of the Transport Logistics Department, Arab Academy for Science and Technology, Cairo, Egypt. P.Box 2033 Horia, Cairo, Egypt. E-mail: Khaled.sakty@aast.edu 2. Mr. Osama is a Researcher in the North Carolina State University (NCSU), USA.

METHODOLOGY

This paper adopts a qualitative approach, with the aim of exploring a phenomenon that has a lack of attention in the available literature, and which subsequently can induce the development of a quantitative research approach in future based on this exploratory research. An overview explains the VUCA Concept and its drivers. Three multiple case studies are discussed to highlight the importance of the VUCA concept. There follows a discussion on how the VUCA concept can improve a supply chain performance. Finally, the conclusion and recommendations are presented.

LITERATURE REVIEW

Previous published research discusses the significance of the supply chain synchronization approach, and some possible reasons for its failure, within specific contexts. Miles (2011) proclaimed that Volatility, Uncertainty, Complexity and Ambiguity (VUCA) drivers are considered to provide an accurate description of the current business environment and this has a direct impact on managing supply chains. From the business perspective, Kambil (2008) defined the four drivers of VUCA. Volatility refers to the change in states per period across processes, while uncertainty refers to the lack of information concerning the present or future states of certain processes that most likely will impact the flow of cash and resource across processes. Complexity refers to the amount of variety in and across processes, as processes may vary to the extent that complexity can coordinate among them. Ambiguity is the absence of clarity about available information and suitable responses.

Sullivan (2012) identified VUCA as an acronym for an environment that is dominated by the fast change of things, in a non-predictable trend or repeatable pattern which is known as Volatility. The situation when major disruptive changes occur frequently is known as Uncertainty. The existence of numerous causes which are difficult to understand, and mitigating factors involved in a problem, is known as Complexity. When the causes and the different circumstances behind the things that are happening are unclear and hard to ascertain, this is known as Ambiguity. Turner (2012) identified the VUCA drivers collaboratively as a combination of the magnitude and speed of change, the lack of predictability and prospect of surprise, the multitude of forces and confounding issues, and the lack of 'one right answer' or single course of action

From the leadership perspective, Volatility refers to the rapid rate of change experienced from the environment, ultimately imposing great pressure on leaders to respond urgently to such change. Uncertainty refers to how leaders with this difficulty manage and make decisions in a remarkably changing environment. Complexity refers to the situation where there are a wide range of factors that account for the situation encountered by a leader, and thus it is considered significantly difficult to diagnose a situation and to formulate effective response and actions. Ambiguity refers to lack of clarity in the way that interpreting or understanding the impact and meaning of events becomes quite difficult (Ambler, 2012).

From the financial perspective, Volatility refers to equity, bond, and currency market volatility; the lack of stability and predictability. Uncertainty refers to the potential change in the inflation index calculation; the lack of ability to foresee what major

changes might come. Complexity refers to the state of understanding the increasing complexity of new financial instruments and regulations to deal with increasingly complex markets. Ambiguity refers to the overall output resulting from the above mentioned drivers (Gardner, 2013). Here follows an exploration of supply chain architecture and the four VUCA drivers.

VOLATILITY FORMULATION AND THE BULLWHIP EFFECT

The literature shows that the type of the volatility inherited within supply chains may be represented by economic or macroeconomic volatility, and by demand volatility. The supply chains of companies across industries have been increasingly affected by the level of economic volatility. There is a wide range of factors that have contributed to such disruption occurring, and moreover placing unexpected pressure on the way these companies source, manufacture and distribute their products. These factors include rapid change in the availability and price of key commodities, major currency fluctuations, disruptive geopolitical events, and continued development of customer channels on a global basis.

In this dynamic environment, such economic volatility can be used as a competitive advantage (Russell et. al, 2009). It becomes clear that the main attributes that account for internal supply chain volatility include both shifts in demand and supply. In other words, the volatile market that companies are deemed to face nowadays, is forcing executives to consider the ability of their firms to be more agile in a way that will turn volatility into an opportunity rather than a threat. And they will have to find those areas where this economic volatility creates opportunities for their business to survive in markets. Fortunately, there are a few strategies that can aid in managing volatile demand efficiently in supply chains:

a) Gangadharan (2007) claimed that companies traditionally used to maintain high levels of buffer inventory in order to meet any fluctuations in demand which may occur. However, this is no longer feasible as a high level of inventory would drain the supply chain resources, cost and time. There are two options for companies to consider; firstly is an evaluation of the tradeoff between the cost of using the capacity buffer strategy and the cost associated with the lost sales due to missed service targets. Secondly, if the companies decide to follow that strategy of a capacity buffer then they have to maintain reliable relationships with their subcontractors.

b) A strategy of reduction in the total supply chain cycle time is an essential ingredient to increase the pace of the flow of information across the supply chain. Consequently, firms can respond faster to changes. Gangadharan (2007) defined total supply chain cycle time as the cumulative sum of the physical cycle time (production time and transportation time) and planning cycle time across a supply chain.

c) Postponement strategy can be applied to enable companies to dramatically reduce inventory while improving customer service (Muzumdar et al., 2003). It entails that companies shift from Make-to-Stock production to Assemble-to-Order production Gangadharan (2007).

d) Collaborative processes strategy aims to cope with fluctuations in demand. It refers to information sharing among supply chain partners. The ability to respond quickly and effectively to continuously changing demands requires an accurate and fast flow of information among the supply chain players. Such visibility can be attained through collaboration between the supply chain players and most importantly with the suppliers and customers.

In a supply chain context, demand volatility refers to unpredictable rates of change affecting the demand side of supply chains, and consequently it focuses on demand variability and the bullwhip concept. A bullwhip effect is the amplification of demand variability from a downstream site to an upstream site, and Cachon et al. (2007) defined it as the phenomenon of increasing demand variability in the supply chain from downstream echelons (retail) to upstream echelons (manufacturing). One of the tools to deal with the bullwhip effect is to use a production smoothing model, where it is assumed that in using inventory as a buffer a firm can smooth its production relative to its sales. However, production is more variable than sales in most industries. Hence, negative findings on the production-smoothing model have been reported (Kahn, 1992; Krane and Braun, 1991; Mosser, 1991; Rossana, 1998).

Moreover, a bullwhip that refers to the upstream amplification of order variability driven by changing retailer demand, is an exogenous supply chain volatility that is referring to the amplification of a steady-state. While temporary cyclical oscillations in orders and inventory levels at the retailer and its upstream suppliers, generated by non-cyclical and non-random retailer demand, is known as endogenous supply chain volatility (Springer and Kim, 2010). These endogenous and exogenous supply chain volatilities present an introduction of two metrics for evaluating supply chain performance. The first metric is the presence and nature of any oscillations in on-hand and pipeline inventory levels. A supply chain architecture design is thereby considered to be volatile if it possesses a tendency to respond to oscillations within the system. The second metric is the factor of time. A supply chain is exposed to demand shocks while operating, where the ability of rapidly converging to its new equilibrium will enable the supply chain to be more stable and less volatile.

UNCERTAINTY MANAGEMENT

Supply chain uncertainty can be viewed in different forms, including situations in the supply chain in which the decision makers lack information about or understanding of the supply chain system (Van der Vorst and Beulens, 2002). There is state of total absence of information or awareness of an upcoming event potentially occurring, irrespective of whether the outcome will have a positive or negative impact (Ritchie and Brindley, 2007). Or it is the lack of information concerning the present or future states of certain processes that most likely will impact the flows of cash and resource across processes (Kambil, 2008; Adamson, 2012). In 1993, Davis proposed an identification of three sources of supply chain uncertainty: demand, manufacturing process, and supply uncertainty. Trkman and McCormack (2009) classified uncertainty into endogenous uncertainty and exogenous uncertainty. Endogenous uncertainty refers to the source of uncertainty/risk that is initiated internally from inside the supply chain and can propagate changing the relationships between a focal firm and its suppliers. Exogenous uncertainty refers to the source of uncertainty/risk

that is initiated externally from outside the supply chain. There was a further division between discrete events and continuous risks.

For managing uncertainty, Mason-Jones and Towill (1998) developed the uncertainty circle model which classified supply chain uncertainty into four levels: process, supply, demand, and control. Process uncertainties refers to the internal reliability of the analysis of a specific process within the supply chain. Supply uncertainty arises as a result of unreliable suppliers and it occurs due to the poor performance of the organization's suppliers who cannot meet the organization's requirements. Demand uncertainty refers to the gap between the actual end-marketplace demand and the customers' orders placed with the organization. Control uncertainty impacts the supply chain capability to transform customer orders into satisfactory deliveries and requests for raw materials from suppliers.

Davis (1993) proposed three strategies to reduce supply chain uncertainty, including total quality control, new product design, and supply chain redesign. Geary et al. (2002) and Gerwin (1993) argued that the strategies of total quality control and new product design can be utilized in an attempt to reduce process uncertainty, and the supply chain redesign strategy to achieve reduction in supply uncertainty. Jones and Towil (2000) recommended that uncertainty reduction can be achieved through implementing two basic decisions. The first decision is to improve the performance of the value added process through lead time reduction and the application of lean thinking to significantly improve quality levels. The second decision is to coordinate work closely with the suppliers which will improve supplier quality, reduce supplier lead times and promote much more consistent delivery patterns. Jones and Towil (2000) proposed that uncertainty reduction ought to involve strategies that manage the uncertainty sources in both the material flow and the order information pipelines. Simangunsong (2012) proposed different ways for coping with different sources of uncertainties, including postponement, volume/delivery flexibility, process flexibility, customer flexibility, multiple suppliers, strategic stocks, collaboration, Information and Communication Technology (ICT) systems, lead time management, financial risk management, and quantitative techniques.

COMPLEXITY MANAGEMENT

Ivanov and Sokolov (2009) argued that global supply chains systems are regarded as a representation of complex adaptive systems that possess no distinct boundaries. Hence, complexity is viewed as a coherent feature of supply chains. Accordingly, complexity management is a crucial aspect in order to avoid any exacerbated uncertainty, risk, or unnecessary cost (Christopher, 2011). Bozarth et. al (2008) claimed that the Supply Chain Complexity (SCC) can be classified into two types of complexity, detail complexity and dynamic complexity. Detail complexity refers to the exact number of components or parts composing a system, and dynamic complexity refers to the lack of predictability in the system's response towards a given set of inputs, driven by the interconnectedness of the many parts that comprise a system.

In a supply chain context, complexity has many aspects that need to be managed in order to improve supply chain performance. The first aspect is diversity, where it is related with the homogeneity or heterogeneity of a system. A high or low level of

diversity of any component of the supply chain leads to the system's heterogeneity or homogeneity and results in either a high or low level of complexity. The second aspect is interdependency. This refers to the extent to which the states within the supply chain system are interdependent. Thus, complexity increases directly proportional to the increase of interdependence (Isik, 2011). The third aspect is variability. It represents the rapid change of elements over a period of time. Variety is the fourth aspect and represents the dynamic behaviour of a system, as variety refers to a state of various differences.

The causes of SCC can be classified as inbound and outbound logistics, sales processes, production engineering production process and new product development (Perona and Miragliotta, 2004). Another approach classified SCC into three aspects: downstream complexity, internal manufacturing, and upstream complexity (Bozarth et al., 2009). Blecker et al. (2005) elucidated that SCC complexity classification can be between structural complexity and dynamic (operative) complexity. However, most research classified supply chain complexity according to its origin: internal and external environmental SCC (Mason-Jones and Towill, 1998; Wildemann, 2000; Childerhouse and Towill, 2004; Blecker et al., 2005; Isik, 2011).

A four-stage complexity management model is proposed to manage complexity in supply chains effectively and efficiently, which covers identifying, measuring, analyzing and controlling complexity. It is worth mentioning that although high complexity indicates high unnecessary costs to the company, in some situations it can add value to the company, as complexity may result in excess inventory which can be useful if a sudden change in demand occurred at such a time (Isik, 2011). Wilding (1998) proposed a 'supply chain complexity triangle' for managing SCC where the SCC complexity was classified through the combination of three independent variables, namely deterministic chaos, parallel interactions, and demand amplification.

AMBUIGUITY MANAGEMENT

In the context of risk or decision-making, ambiguity is viewed as the unknown possible outcomes. Whilst in an economic context, ambiguity is defined as the lack of understanding considering the fundamental principles that drive risk (Grant, 2013). Also, it can be defined as the lack of clarity about the meaning of an event (Caron, 2009). Ambiguity can also be defined as the inability to accurately conceptualize threats and opportunities before they become lethal.

The relationship between ambiguity and information sharing is illustrated throughout the context of the definition of the ambiguity driver. Watts (2006) described ambiguity as representing the lack of knowledge of the decision makers not the lack of information, capturing both the uncertainty involved in the roles of individuals in a distributed problem solving activity and the environmental uncertainty. Hence, the importance of sharing information to enhance the supply chain performance has been widely acknowledged in the literature.

Christopher (2011) argued that the amount of data flowing in all directions across the supply chain is immense, which can be prone to misinterpretation by players as the

visibility of accurate relevant data can be interrupted through unnecessary modification of information as it passes from one entity or level to another.

Managing ambiguity requires sharing accurate and correct interpretations across processes. Some of the key responses to tackle ambiguity other than information systems are:
*coordinators who are aware of the languages and systems across processes;
*jointly reviewing unexpected variances or information across processes and ensuring that both sides have a common interpretation of events through proposed decision frameworks;
*verifying hypotheses and achieving clarity in ambiguous situations by implementing joint planning and coordination across processes that challenges joint assumptions (Kambil, 2008).

CONCLUSION

The significance of the VUCA concept and drivers in business has been elaborated here through the literature gathered, to show how it greatly affects the supply chain management aspect. The VUCA drivers best describe the challenging environment within which businesses operate. It was observed by this researcher that although some of the VUCA drivers were studied by a wide range of researchers, however these studies interpreted the impact of each driver on the supply chain management independently, whereas more recent studies analyzed the correlated aspects between two of the drivers. Hence, this present conceptual paper aims at an exploration of the VUCA concept and its drivers and how the drivers of the VUCA concept can affect the overall supply chain performance. This paper has focused on the relationships amongst the four VUCA drivers as to how they affect supply chain performance. It has found that many businesses have adopted the concept of agility in their supply chains to cope with the VUCA drivers. However, additional aspects need to be considered in order to master managing the VUCA drivers and moreover enable businesses to convert the challenges imposed by the VUCA drivers into a competitive advantage.

Findings

First, the VUCA concept became a competitive requirement for companies, who had to be fully aware of its drivers in order to survive in such a scary environment. Second, integrating the Volatility, Uncertainty, Complexity and Ambiguity drivers into a supply chain architecture is necessary to be able to sustain profitability in this challenging environment. Third, VUCA drivers helps to gain a competitive advantage in the supply chain. Fourth, VUCA can be used by leaders and managers as a method for altering the traditional supply chain models.

The Value of this Paper

Such combination of drivers has become vital in the current situation of the global world, rather than companies addressing each force separately with different strategies, while neglecting the interdependence between some of these forces. Hence, this research aims to design a Supply Chain Architecture based on the VUCA concept in order to enhance supply chain performance, to assist companies to create an 'end to end agile supply chain' to cope with the inevitable effect of the VUCA drivers.

Moreover, these companies will stand to gain a competitive advantage by running the business both efficiently and effectively.

REFERENCES

- Adamson, C. (2012, November 13). Learning in a VUCA world - How Knowledge Workers learn to innovate. *ONLINE EDUCA BERLIN*, [web log] Retrieved from: http://www.online-educa.com/OEB_Newsportal/learning-in-a-vuca-world-how-knowledge-workers-learn-to-innovate/ [Accessed: 6 AUG 2013].
- Ambler, G. (2012, November 16). VUCA: Leading in Turbulent Times. *George Amble on Leading in Turbulent Times*, [web log] Retrieved from: http://www.georgeambler.com/vuca-leading-in-turbulent-times/ [Accessed: 10 AUG 2013].
- Blecker, T., Kersten, W. and Meyer, C.M. (2005). *Development of an approach for analyzing supply chain complexity*, Mass Customization. Concepts-Tools-Realization, Gito Verlag, Berlin, pp. 47–59.
- Bozarth, C., Warsing, D., Flynn, B. and Flynn, E. (2009). The impact of supply chain complexity on manufacturing plant performance. *Journal of Operations Management*, 27 (1), pp. 78--93.
- Cachon, G., R, All, T. and Schmidt, G. (2007). In search of the bullwhip effect. *Manufacturing & Service Operations Management*, 9 (4), 457-479.
- Caron, D. (2009). It's a VUCA world. CIPS. Retrieved from http://www.slideshare.net/dcaron/its-a-vuca-world-cips-cio-march-5-2009-draft.
- Childerhouse, P., and Towill, D. R. (2004). Reducing uncertainty in European supply chains. *Journal of Manufacturing Technology Management*, 15(7), 585-598.
- Christopher, M., (2011). *Logistics & Supply Chain Management,* 4th ed., Harlow, England: Financial Times Prentice Hall.
- Davis, T. (1993). Effective supply chain management. *Sloan Management Review.*, 34(4), 35-46.
- Gangadharan, R. (2007). Supply Chain Strategies to Manage Volatile Demand. *SUPPLY & DEMAND CHAIN EXECUTIVE*, [web log] Retrieved from: http://www.sdcexec.com/article/10289792/supply-chain-strategies-to-manage-volatile-demand [Accessed: 14 MAY 2013].
- Gardner, R. (2013). VUCA - THE ACRONYM OF OUR TIME. *Red blog*, [web log] Retrieved from: http://blog.redington.co.uk/Articles/Robert-Gardner/August-2013/VUCA-THE-ACRONYM-OF-OUR-TIME.aspx [Accessed: 30 SEP 2013].
- Geary, S., Childerhouse, P. and Towill, D. (2002). *Uncertainty and the Seamless Supply Chain.* [PDF] SUPPLYCHAIN MANAGEMENT REVIEW. http://nebula.wsimg.com/266e8b7fd87ffe1c4015a510af51934f?AccessKeyId=681EDB3F0F969CD93EE9&disposition=0 [Accessed: 1 JUN 2013].
- Gerwin, D., (1993). Manufacturing flexibility: a strategic perspective. *Management Science*, 39 (4), 395–410.
- Grant, P. (2013). *Difference Between Risk & Ambiguity / eHow.* [online] Available at: http://www.ehow.com/info_8547566_difference-between-risk-ambiguity.html [Accessed: 12 AUG 2013].
- Isik, F. (2011). Complexity in Supply Chains: A New Approach to Quantitative Measurement of the Supply-Chain-Complexity. *Supply Chain Management*, pp. 417-432.

- Ivanov, D. and Sokolov, B., (2009). *Adaptive Supply Chain Management*, Springer
- Jones, R. and Towill, D. (2000). *Coping with Uncertainty: Reducing "Bullwhip" Behavior in Global Supply Chains*. [e-book] Supply Chain Forum. http://www.supplychain-forum.com/documents/articles/ACF62.pdf [Accessed: 23 AUG 2013].
- Kahn, J. (1992). Why is production more volatile than sales? Theory and evidence on the stock out-avoidance motive for inventory holding. *Quarterly Journal of. Economy.* 2, 481–510.
- Kambil, A. (2008), Synchronization: moving beyond re-engineering, *Journal of Business Strategy*, Vol. 29, Iss: 3 pp. 51 – 54, "[Online]" Available at: Permanent link to this document: http://dx.doi.org/10.1108/02756660810873236 [Accessed 10 May 2013]
- Krane, S., S. Braun. (1991). Production smoothing evidence from physical product data. *Journal of. Political Economy*. 99 558–581.
- Mason-Jones, R., and Towill, D. R. (1998). Shrinking the supply chain uncertainty circle. *IOM Control*, 24(7), 17–22.
- Miles, T. (2011), 'VUCA, a useful acronym for today's supply chain', *kinaxis,* weblog post, 9 June, accessed 1 may 2013, http://blog.kinaxis.com/2011/06/vuca-a-useful-acronym-for-todays-supply-chain/
- Mosser, P. (1991). Trade inventories and (S,s). *Quarterly Journal of Economics.* 106 1267–1286
- Muzumdar, M., Colehower, J., Pernat, A., and Matthews, P., (2003), The Adaptive Supply Chain: Postponement for Profitability, APICS International Conference and Exposition.
- Ritchie B and Brindley C (2007) Supply chain risk management and performance: a guiding framework for future development. *International Journal of Operation & Production Management.* 27(3):303–322
- Rossana, R. (1998). Structural instability and the production smoothing model of inventories. *Journal of Business Economic. Statistics.* 16 206–215.
- Russell, J., Pearson, M. and Read, B. (2009). *High Performance in a Volatile World: Seven Imperatives for Achieving Dynamic Supply Chains*. [PDF] Accenture. http://www.accenture.com/SiteCollectionDocuments/PDF/Accenture_CGS_Seven_Imperatives_for_Dynamic_Supply_Chains.pdf [Accessed: 7 JUN 2013].
- Simangunsong, E., Hendry, L. and Stevenson, M. (2012). Supply-chain uncertainty: a review and theoretical foundation for future research. *International Journal of Production Research*, 50 (16), pp. 4493--4523.
- Springer, M. and Kim, I. (2010). Managing the order pipeline to reduce supply chain volatility. *European Journal of Operational Research*, 203 (2), pp. 380--392.
- Sullivan, J. 2012. 'VUCA: The new normal for talent management and workforce planning', Ere.net. Retrieved from http://www.ere.net/2012/01/16/vuca-the-new-normal-for-talent-management-and-workforce-planning/ [Accessed 20 July2013]
- Trukman, P. and McCormack, K. (2009). Supply chain risk in turbulent environments - A conceptual model for managing supply chain network risk. *International Journal of Production Economics*, 119 (2), pp. 247--258.
- Turner, C. (2012). Control and Growth – Tipping the Balance in a VUCA World. *steelwedge*, [web log] Retrieved from:

http://info.steelwedge.com/rs/steelwedge/images/chris_turner_control_and_growth_2012_OK.pdf [Accessed: 12 AUG 2013].

- Van der Vorst, J. G. A. J., and Beulens, A. J. M. (2002). Identifying sources of uncertainty to generate supply chain redesign strategies. *International Journal of Physical Distribution Logistics Management*. 32(6), 409–430.
- Watts, D. (2006). Surviving the Short Run: Ambiguity, Information Exchange, and Robustness of Organizations. *Department of Sociology Columbia University*.
- Wildemann, H., (2000), Komplexitätsmanagement: Vertrieb, Produkte, Beschaffung, F&E, Produktion, Administration, TCW Report -1st edition, TCW Transfer-Centrum GmbH, Munich.
- Wilding, R. (1998). The supply chain complexity triangle: Uncertainty generation in the supply chain. *International Journal of Physical Distribution Logistics Management.*28(8), 599–616.