

# Critical Indices and Model of Uncertainty Perception for Regional Supply Chains: Insights from a Delphi-based Study

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Supply chains typically span different regions of the world and practitioners grapple on a global scale with perceived uncertainty. Perceptions of uncertainty stem from questions, such as:

What will my customers order?

How many products should we have in stock?

Will the supplier deliver the requested goods on time and according to the demanded specifications?

Such questions are indices (or measures) of perceived uncertainty that raise a myriad of supply chain management (SCM) challenges, and there is no panacea for confronting variability, volatility and vulnerability due to these questions. In light of these challenges, evaluations of supply chain uncertainty have a propensity to apply multi-criterion decision-making (MCDM) methods that inform option selection, assess the relative impact and adopt mitigation strategies. For regional supply chains "that conduct the majority of upstream and downstream activities in their home regions", SCM tends to reflect intra- and inter-regional strategies for economic development and environmental sustainability. Subsequently, uncertainty in this context depends on varied influences and specificities as perceived by regional SCM practitioners and prioritizations that shape SCM design decisions. However, an analysis of SCM research suggests a gap in knowledge on how regional SCM practitioners perceive uncertainty and on the critical indices of uncertainty for regional supply chains. This constitutes the research gap for this study, which was participated by each of Dr. Christopher M. Durugbo, from Arabian Gulf University at Bahrain, Dr. Zainab Al-Balushi, from Sultan Qaboos University at Oman, and Dr. Omar Amoudi, from National University of Science and Technology at Oman.

This paper aims to identify the critical indices of uncertainty for regional supply chains and analyze how SCM practitioners perceive uncertainty. Specifically,



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the research applies the widely used Delphi process in a study involving SCM practitioners from the Gulf Cooperation Council (GCC) region to advance research at the interface between SCM and operations strategy. Thus, the rationale of this research is that indices and theorizations relating to uncertainty perception may further enhance design decisions and strategy concerning the influences and specificities of SCM for regional supply chains.

In the area of managerial decision-making for supply chain uncertainty, researchers apply MCDM methods such as analytical hierarchical process and theory of constraint, data envelopment analysis, grey relational analysis, interpretive structural modelling and fuzzy techniques. However, Delphi offers an appropriate MCDM approach for this study because it uniquely supports an iterative process allowing participants to revise choices, allows anonymity for true opinions to emerge, and supports high conflict situations involving multiple decision makers. In addition, Delphi is suitable for addressing the main aim of this study because it supports group consensus in the identification (and prioritization) of issues and in the modelling of perceptions, such as supply chain uncertainty.

The Delphi process is widely used in SCM research to identify and prioritize research opportunities and for decision models. Previous areas of use include sustainable SCM, big data applications and understanding for SCM and SCM for flexibility and excellence. This study specifically applies an online version of the Delphi process (i.e. e-Delphi) for expert insights, anonymity and controlled feedback for the prioritization of issues. Because the Delphi process relies on multiple rounds of systematic enquiry to reach panel consensus, a key challenge for using the process is striking a balance in the number of rounds used to gather opinions. It is for this reason that two or three rounds of polling are typically used in Delphi-based SCM studies. Too many rounds may raise commitment issues with the panel and too few rounds

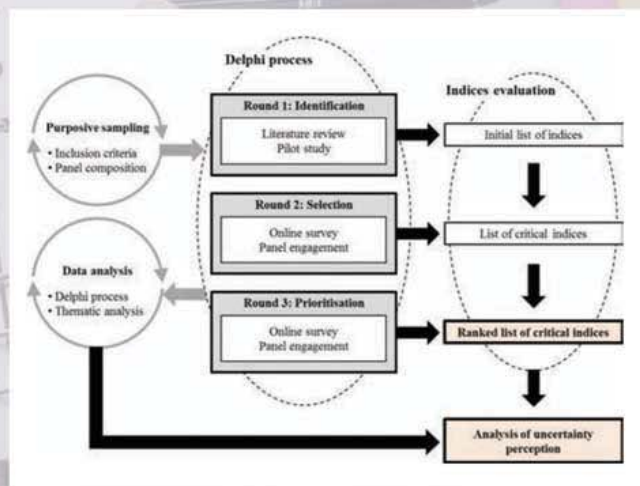


Figure 1. Flow chart for research methodology.

would produce underdeveloped conclusions. With this in mind, the article presents a three-stage Delphi-based study with SCM practitioners from the GCC region to confront the following research questions:

RQ1. What are the critical indices of regional supply chain uncertainty?

RQ2. How do regional SCM practitioners perceive uncertainty in supply chains?

This study is relevant to regional SCM practitioners and researchers in two main ways. First, as an uncertainty assessment that replicates and updates research on indices of supply chain uncertainty but from the perspective of developing countries and specifically the GCC region. This assessment is a useful competence in setting parameters for SCM tools such as supply chain audits that are conducted to appraise supply chain operations and collaborative readiness assessments that inform decisions to admit/omit supply chain partners. Second, as an uncertainty theorization that offers knowledge to inform the setting of performance objectives for supply chain strategies. As a critical metric for success, supply chain strategies provide an important basis of competition that trigger firms to amalgamate operations strategy with contemporary marketing and business policies such as user-generated content, co-creation and brand influencers. It is for this reason that knowledge from related studies of supply chain uncertainty has been applied in supply chain planning that leverages competitive business models and underscores relationship-building skills for SCM.

### Research methods

The research applied thematic analysis after the Delphi process to methodically understand and identify patterns from the collected data. The intention was to analyze how SCM practitioners perceive uncertainty. The analysis involves deciphering and interpreting common themes of the ranked critical indices of supply chain uncertainty. The focus was on identifying factors shaping perception based on analyzing the sentences that describe the uncertainty e.g. 'rate of new product

introduction' and 'replacing supplier of critical material'. Part of the analysis is also devoted to theorizing on the process for uncertainty perception and knowledge for this aspect of the analysis stems from observing the entire Delphi process. Figure 1 illustrates the applied method.

### Main Results

In terms of the factors that shape perceptions, the analyzed critical indices reveal three critical C themes that underpin questions surrounding the critical indices of supply chain uncertainty. The three critical Cs are cost, context and customer, as shown by Figure 2.

Cost-related perceptions concern potential changes due to costs associates with projects, keeping up with technology, and unexpected orders or demands. In this context, perceived uncertainty relies on visible and reliable cost-effectiveness measures adopted within the supply chain. Confidence levels of SCM practitioners for costs also stem from credible and effective forecasts in estimates. These estimates may in turn influence degrees of uncertainty in virtuous (or vicious) circles concerning on-going and prospective expenditures for product development, production, service, and disposal of equipment. Cost controls become imperative for supply chain planning and regulations, and to curb regional and organizational expenditure within both public and private sectors whilst remaining competitive.

Conformance-related perceptions characterize changes and delays surrounding the fulfilment of customer requirements by supply chains in relation to materials, orders and quality. In this respect, perceived uncertainty hinges on confidence levels for high quality and timely delivery by supply chains. In supply chains, confidence levels underpin the orchestration that aids practitioners in enhancing operational performance. This leads to decisiveness for regional supply chains that are agile i.e. respond to short-term changes in demand or supply quickly and handle external disruptions smoothly; adaptable i.e. adjust their strategies, products, and technologies to meet structural shifts in markets; and aligned i.e. bring into line the interests of all partners– the so called 'Triple-A' supply chain paradigm.

Connection-related perceptions apply to changes in platforms, systems and applications concerning information use, updated technology and infrastructure availability. Here, the perceived uncertainty depends on accuracy, availability and transparency that facilitates resource use in information environments for supply chains. These environments dictate governance as regions face an optimization problem of maximizing their welfare while minimizing barriers to business environments for investors.

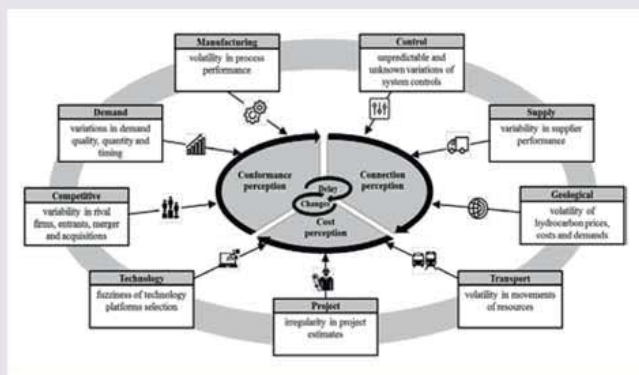


Figure 2. The three critical Cs (cost, conformance and connection) shaping uncertainty perception.