A Delphi-AHP-TOPSIS based benchmarking framework for performance improvement of a cold chain

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ABSTRACT

This paper aims to develop a benchmarking framework that evaluates the cold chain performance of a company, reveals its strengths and weaknesses and finally identifies and prioritizes potential alternatives for continuous improvement. A Delphi-AHP-TOPSIS based methodology has divided the whole benchmarking into three stages. The first stage is Delphi method, where identification, synthesis and prioritization of key performance factors and sub-factors are done and a novel consistent measurement scale is developed. The second stage is Analytic Hierarchy Process (AHP) based cold chain performance evaluation of a selected company against its competitors, so as to observe cold chain performance of individual factors and sub-factors, as well as overall performance index. And, the third stage is Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) based assessment of possible alternatives for the continuous improvement of the company’s cold chain performance. Finally a demonstration of proposed methodology in a retail industry is presented for better understanding. The proposed framework can assist managers to comprehend the present strengths and weaknesses of their cold. They can identify good practices from the market leader and can benchmark them for improving weaknesses keeping in view the current operational conditions and strategies of the company. This framework also facilitates the decision makers to better understand the complex relationships of the relevant cold chain performance factors in decision-making.

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1. Introduction

A ‘cold chain’ is comprises of equipments and processes that keeps perishable products under conditioned environment. These perishable products can be categorized into two types: living products (fruits, vegetables, live seafood, flowers, etc.) and non-living products (meat, dairy products, processed food products, medicines, blood, frozen products, etc.), which all require appropriate atmosphere to defy microbial spoilage (Donselaar, Woensel, Broekmeulen, & Fransoo, 2006). In today’s competitive environment, perishable products are one of the main drivers through which retailers are attaching additional customers to increase profitability. Heller has stated that the quality of perishable goods assortment is becoming the core reason many customers choose one retailer over another (as cited in Thron, Nagy, & Wassan, 2007). The global market for perishable goods such as cooled products and processed foods is growing due to changing lifestyles and overall declining prices.

Retailers who are in the business of perishables can find a direct correlation between the cold chain performance and the quality delivered to the customer. Any disorder in time–distance or temperature in the cold chain could hamper the net present value of the activities and adversely influence the overall performance (Bogataj, Bogataj, & Vodopivec, 2005). Since long time, the cold chain data has been under utilized and used solely for the purposes of evaluating the integrity of individual shipments (i.e. facilitating the accept or reject decisions). These data can be gathered to measure performance of the cold chain, which in turn can identify flaws and weaknesses in the processes.

Benchmarking is a well-defined tool for improving these weaknesses through improvement processes in which a company measures its performance against that of market leaders, finds how market leaders have achieved their performance levels, and prudently uses this knowledge to improve its own performance (Saunders, Mann, & Smith, 2007). A well defined performance measurement system (PMS) aims to support the setting of objectives, evaluating performance, and determining future courses of action on a strategic, tactical and operational level (Gunasekaran, Patel,
and image, long production throughput time, refrigerated trans-
physical product features like appearance, taste, odor, color, size
supply chains like shelf life constraints, seasonality in production,
2. Literature review

In India it is estimated that around 35–40% of the total produc-
ture of fresh fruits and vegetables, is wasted only because of inade-
quitable cold storage, poor logistics, ineffective cold chain facilities
Although, India is the second largest producer of fruits and vegeta-
world, but at the current level of production, the farm
produce valued at Rs 70,000 million ($1400 M) is lost in wastages
which is tantamount to the total production of the Great Britain
(Khan, 2005). The high margin of product losses offers a significant
opportunity for the improvement and advocates for technology
and research advancement with in this domain. As one cannot im-
prove what one cannot measure, the necessity of the hour is to
measure the current status of Indian cold chain performance.

In light of above, this research paper delves into the perfor-
ance improvement of the cold chain in Indian context. Here, a
framework is proposed for performance evaluation of the cold
chain and its improvement through effective benchmarking. This
framework is suitable for the actual situations of the cold chains
in the Indian retail market. The relevant information was collected
from the field visits to various retail stores in India followed by an
extensive literature review and consultation with the experts.

1.2. Research goal

This research mainly discusses the Key Performance Factors
(KPF) of Indian cold chain, so as to provide a consistent measuring
system to establish the basis of an evaluation reference. Based on
this consistent measuring system the cold chain performance in-
dex of the chosen company can be measured against its competi-
tors’. Subsequently the strengths and weaknesses of the company
can be identified and their competitive gains and losses can be
examined. These identified weaknesses can be considered as the
performance gap or an opportunity for improvement. Further, for
improving the weaknesses, the best practices learnt from the mar-
ket leader are then short-listed and examined against current oper-
alional conditions of the selected company to choose the preferred
one for bridging the performance gap. This should be a continuous
improvement process as the company can improve its weaknesses
one after another.

1.3. Research scope and target group

The companies trading in perishable products like fruit and
vegetable, flowers, milk and milk product, meat and meat prod-
products, etc. are focused upon. The research scope is the cold chain
operations of the companies that provide direct link between
grower/producer–processor–distributor–retailer). They resonated in their views that cold chain is frequently
broken at various stages. This drastically reduces its performance.
In this regard Fearne and Hughes (2000) discussed supply-chain
developments in the UK fresh produce industry and identified vari-
ous success factors like improvement in cost control and innova-
tion, etc. Bogataj et al. (2005) have studied the stability of perishable goods in logistic chains and discussed the disturbances
which reduces the hygiene and quality of perishables. For perish-
able, maintaining the hygiene, safety, and expectedness of quality
and freshness requires efficient equipment with guaranteed ther-
cal characteristics, appropriate operating modes and proper infor-
(2008) observed that identification of the critical parameters
affecting food quality and safety and quantification through a sys-
tematic modeling approach will allow monitoring the quality and
safety status of food products throughout the cold chain.

The traceability issues were taken by many researchers
(Kelepouris, Pramatari, & Doukides, 2007; Regattieri, Gamberi, &
Manzini, 2007; Folinas, Manikas, & Manos, 2006; Joshi et al., in press) and have stated the need for reliable IT infrastructure of cold
chain. In supplement to this, Rijswijk & Frewer (2008) investigated that traceability is linked not only to food safety, but also to food
quality. Taylor & Fearne (2006) have observed that most significant challenge in cold chain management is continuous imbalance be-
tween supply and demand which is supported by Gorton, Dum-
itrashko, & White (2006) while discussing the issues overcoming the
supply-chain failure in agri-food sector. At retail level maint-
aining cold chain, inventory control and return policy of perish-
able items are also some issues which have been referred to in the
literature (Donselaar et al., 2006 & Likar & Jevsnik, 2006).
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