



Supply Chain Management: An International Journal

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Article information:

To cite this document:

Luai E. Jraisat Ihab H. Sawalha, (2013), "Quality control and supply chain management: a contextual perspective and a case study", Supply Chain Management: An International Journal, Vol. 18 Iss 2 pp. 194 - 207

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Quality control and supply chain management: a contextual perspective and a case study

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Abstract

Purpose – This paper aims to explore the factors of quality control (QC) among key members of a supply chain and investigate the effect on supply chain management (SCM).

Design/methodology/approach – This research employs a case study approach of five firms in the fresh fruit and vegetable supply chain in Jordan. Cases are first analysed individually. Then a cross-analysis supplemented with archival material and non-participant observation is made. A questionnaire is also conducted in order to analyse the effect of QC on SCM.

Findings – The findings identify the high-order factors of QC and demonstrate the role of QC in SCM, acting as the main strategy to improve supply chains.

Practical implications – The case studies draw on the experiences and views of supply chain members in order to improve the understanding of the role of QC in SCM. The proposed conceptual framework can help managers in understanding the factors of supply chain QC.

Originality/value – This is one of only a few studies that examine QC in the supply chain. It is also one of only a few research studies to provide empirical evidence of the role of QC in SCM for the fruit and vegetable industry.

Keywords Supply chain management, Quality control, Exports, Fruit and vegetable industry, Jordan

Paper type Research paper

1. Introduction

Romano and Vinelli (2001) and Casadesús and de Castro (2005) have highlighted the necessity of understanding the potential role of quality control (QC) in supply chain management (SCM). A holistic view of QC in SCM is still largely underexplored. The ability to compete in fresh food markets by adopting successful export supply chains is critical to a firm's QC. Yet, there is no full understanding of QC and it is one of the least recognised areas of SCM. QC can create close supply chain relationships that ensure a tight control over production-marketing systems, so they can co-operate and coordinate in more practical ways concerning fruit and vegetable issues in order to minimize transaction costs and exporting risks (Shaw and Gibbs, 1995). Such issues include chemical treatments, fruit and vegetable varieties, quality standards, supply timetables, joint export planning and information sharing strategy within their relationship and with their networks. What is clear is that QC is multidimensional. This paper aims to examine the role of QC in supply chains and how factors of QC can improve SCM. Previous studies have either examined the factors individually or have concentrated on a sub-set and, to our knowledge; this is the first attempt to develop an integrated

conceptual framework. The empirical application is to the context of the Jordanian fresh fruit and vegetable industry.

The paper is structured as follows. In Section 2, a review of SCM and QC literature is undertaken. Section 3 provides the research methodology. Section 4 presents findings and discussions, providing the integrated conceptual framework for the study of QC in fresh fruit and vegetable chains. The last section highlights conclusions and clarifies contributions made by this research.

2. Literature review

Waters (2007) defines SCM as: “the function responsible for the transport and storage of materials on their journey from original suppliers, through intermediate operations, and on to final customers”. SCM consists of all activities required to fulfil customers' needs. It incorporates the management of products, information flow, and business relationships (Christopher, 1998; Chopra and Meindl, 2001; Wu *et al.*, 2004; Casadesús and de Castro, 2005; Carmignani, 2009; Wang and Li, 2012). The existing literature on the SCM focuses mainly on the development, application, and integration of relationships, networks, logistics, and purchasing and performance. Few studies investigate the role of QC in SCM.

QC is defined as “the function which aims to measure and improve the production and marketing processes and the product and information flow in order to provide products

The current issue and full text archive of this journal is available at www.emeraldinsight.com/1359-8546.htm



Supply Chain Management: An International Journal
18/2 (2013) 194–207
© Emerald Group Publishing Limited [ISSN 1359-8546]
[DOI 10.1108/13598541311318827]

Received: 1 March 2012

Revised: 21 July 2012

Accepted 27 July 2012

according to specification” (Faria-Fernandes *et al.*, 2009). QC is significant for manufacturing and services, and has become a prerequisite for success in export markets (Martinez and Poole, 2004; Carmignani, 2009; Talib *et al.*, 2011). QC of both products and services at each level of the supply chain is an essential part of successful SCM (Choi and Rungtusanatham, 1999; Cagnazzo *et al.*, 2010). In the fruit and vegetable SCM, QC is related to a range of factors, such as product quality, timely delivery, training, information quality, communication, customer satisfaction, relationship quality, commitment, leadership, business continuity and timely receipt of finished goods (Martinez and Poole, 2004; Van-Der-Vorst *et al.*, 2007). Table I illustrates previous studies related to QC factors.

An expansion in perishable products has drawn attention to the major disparities between countries in terms of standards for food safety and public health. Supermarkets have to meet requirements of the existing safety legislation in most of the European Union, by considering systems that control fresh products from the field to the supermarket. QC of fresh products can be considered as a dynamic state that decreases continuously until the point when it is unfit for consumption (Wang and Li, 2012). According to Martinez and Poole (2004), food safety and quality standards are key elements of QC in international trade. In the export market of fresh fruit and vegetables, there are three QC systems: the hazard analysis critical control point (HACCP) (Vladimirov, 2011; Zhang and Chen, 2011), the International Organisation for Standardisation (ISO), and the Euro-retailer produce good agricultural practices (EurepGAP) (Martinez and Poole, 2004; Davis, 2005; Zuniga-Arias *et al.*, 2009). The system of good agricultural practices is a harmonised certification scheme for suppliers of fresh produce, prepared by many large European Union retailers in 1997 (Martinez and Poole, 2004).

Subsequently, firms should apply good management practices based on effectiveness of QC of supply chains from the following aspects: pre-planning, production control, harvest, post-harvest (i.e. packaging and transportation), and marketing (Zhang and Chen, 2011). They should also interact with export partners, linking their production and marketing functions through technology adoption and quality issues in a cost-effective manner. Product design, production processes, packaging, information sharing, and other marketing conditions, will provide a competitive edge within business in the European Union.

In SCM, QC helps to manage different processes within firms and between them. In this regard, QC has the potential to maximise the ability to provide a system of better functions which improves supply chain relationships and performance (Flynn *et al.*, 1994; Van-Der-Vorst *et al.*, 2007). A key element of a successful supply chain involves the downstream integration of business customers and the management of upstream suppliers (Tan, 2002). Integration occurs by considering product flow, information flow, logistics providers, planning and communication within well-controlled supply chains.

Safety standards for QC in both developed and developing countries may exclude producers, who may face distinct problems in the supply chain, such as how to produce safe food, identify cost-effective technologies for reducing risk, and compete with larger producers (Humphrey, 2004). Applications of right technologies (e.g. cooling equipment

and sensors use) result in better process control, hygiene, new equipment and better inventory management, which improve business performance in industries (Orr, 1999). Technology also includes shelf-life testing, sensory analysis, chemical analysis, evaluation of structural changes, colour, storage humidity, and gas analysis for products (Pegg, 1999).

As supply chains become more complex, their management plays an increasingly important role in the delivery of high value products to distant markets (Davis, 2005). Given the perishable nature of fruit and vegetables and the demand for quality and safety attributes, relationships and networks are needed greatly in order to manage the flow of products between importers, exporters, and producers. Developing countries play a major role in supplying the European Union with fruit and vegetables. This is where the marketing chains vary in relation to the type of retail outlet and between countries.

As a result of the increasing export marketplace, communications between upstream sellers and downstream buyers is required. QC should expand from a firm level to include the entire supply chain. Research has addressed the need to increase QC in supply chains that contain many functions that need to be controlled (Romano and Vinelli, 2001; Tapiero, 2007; Zuniga-Arias *et al.*, 2009; Carmignani, 2009; Cagnazzo *et al.*, 2010; Holschbach and Hofmann, 2011; Yi *et al.*, 2011; Baird *et al.*, 2011; Vladimirov, 2011; Zhang and Chen, 2011; Wang and Li, 2012). Improving the quality of supply chain processes leads to cost reductions, improved resource utilisation and improved process efficiency (Beamon and Ware, 1998; Vladimirov, 2011).

A number of studies has investigated how buyer-seller relationships can influence the quality of both products/services and processes. These studies, however, focused on a single firm or on its immediate suppliers and customers only (e.g. Tan, 2002). Few studies have considered QC (e.g. Choi and Rungtusanatham, 1999). Indeed, many benefits can be gained from managing the flow of products and information between buyers' buyers and sellers' sellers in order to improve QCs. In the supply chains, the quality level delivered to the final customer is a result of QC management of each link and player.

In many countries, the implementation of QC is determined by a set of factors. Some of these factors have been discussed in the literature. The literature indicates that firms respond differently to the development and implementation of QC systems. In the fruit and vegetable supply chains, these differences persist among input suppliers, distributors, retailers and logistic providers, and among government and large private firms (Wilson, 1996; Lazzarini *et al.*, 2001; Tan, 2002; Van-Der-Vorst *et al.*, 2007; Duffy, 2008; Zuniga-Arias *et al.*, 2009). That is why the significance of factors for adoption of a fruit and vegetable QC system depends on the stage of the development of firms, sectors, and even countries.

Despite the potential advantages of quality controls (Baird *et al.*, 2011), small firms might be unwilling or find it hard to implement them (Mikkola, 2008). At the same time, fruit and vegetable firms are under pressure from leading importers to have a quality certification and high quality products in order to bid for contracts and make agreements. According to Aksoy and Kaynak (1994), Harland (1996), Hoyt and Huq (2000), Lazzarini *et al.* (2001) and Duffy (2008), the main obstacles that hinder the implementation of a QC system

Table I Research on QC and SCM

Research	Factors of QC												
	Commitment	Communication	Product quality	Information quality	Continuity	Satisfaction	Leadership	Training	Environment factors	Policy making	Quality protocol	Personal relationship	Financial support
Wilson (1996)		✓	✓			✓		✓	✓			✓	
Romano and Vinelli (2001)	✓	✓	✓	✓		✓						✓	
Cadhon <i>et al.</i> (2003)			✓					✓		✓		✓	
Martinez and Poole (2004)		✓	✓	✓		✓					✓		✓
Parker <i>et al.</i> (2006)	✓	✓	✓	✓		✓		✓				✓	
Faria-Fernandes <i>et al.</i> (2009)			✓	✓		✓							
Mikkola (2008)	✓	✓	✓	✓		✓		✓				✓	
Faria-Fernandes <i>et al.</i> (2009)		✓	✓			✓					✓		
Zuniga-Arias <i>et al.</i> (2009)		✓	✓	✓	✓	✓		✓				✓	
Carmignani (2009)		✓	✓	✓		✓							
Baird <i>et al.</i> (2011)			✓	✓		✓							
Talib <i>et al.</i> (2011)	✓		✓	✓	✓	✓		✓				✓	
Holschbach and Hofmann (2011)			✓	✓		✓							✓
Vladimirov (2011)		✓	✓	✓		✓		✓					

include: weak links between buyers and sellers; limited financial and human resources; inadequate expertise, training, and information sharing, and the lack of trust in food safety legislations and inspectors.

Understanding the quality of supply chains requires analysing the internal environment (e.g. country facilities and infrastructure, product quality and standards, exporter-producer relationships and marketing research). Exporting encourages buyers and sellers to become less dependent on the domestic market. Although exporting firms lack a direct presence in the host environment, they may still benefit from inside knowledge from customers, competitors and suppliers to gain international experience (Salomon and Shaver, 2005). Exporters can hire host-country employees to take expertise back to the home country, which allows firms access to the market, technological information, and QC conditions.

Export-oriented fruit and vegetable industry is highly technical, and success is dependent on the adoption of appropriate cultivars and technologies, as well as appropriate investment in inputs, infrastructure, and quality (Humphrey and Schmitz, 2001). Competition arising from the globalisation of markets and production highlights the need for increasing the quality standards, such as size, shape, colour, and freshness. Moreover, entering into foreign market allows exporters to obtain new information that can help firms tailor products to meet their needs. The challenge for modern fresh food producers is to develop relationships within supply chains. Dolan and Humphrey (2000) note that there are requirements in order to expand the export of fresh products. These include: relationship concentration in the large firms; organisational capabilities for supply of high quality; and infrastructure facilities arising from market power. The fruit and vegetable industry is characterised by a lack of reliable information, which affects how products can be connected with consumers in the chains for delivering benefits to all members based on better factors of QC. Zhang and Chen (2011) indicated that applying critical control points in fruit and vegetable supply chains will enhance control over product and chain quality.

Research has examined single members of the supply chain only. Few studies (e.g. Romano and Vinelli, 2001; Carmignani, 2009; Baird *et al.*, 2011) have analysed multi-players. Nevertheless, they have not provided detailed empirical work related to QC. Most of studies have examined the chain QC in different industries or multi-industries. Few (e.g. Vladimirov, 2011) have examined QC in the fresh food industry and fruit and vegetables. Most of the research studies are confined to a single firm and thereby neglect the other processes in the supply chain, such as communication and leadership. As the frameworks for QC employed in these studies did not include multiple interdependencies that exist among supply chain members, their proposed options were less applicable to supply chain managers and researchers. Table II illustrates the factors of QC in the supply chain, their definitions, and key supporting research.

Despite this recognition of the dual purpose of QC strategies, little work has been done to synthesize these competing uses to provide supply chain researchers and managers with a pioneering approach to assess supply chains. This research will attempt to identify the high-order factors of QC and examines the impacts of these factors in order to

improve the management of the fruit and vegetable supply chain.

3. Research methodology

This research followed an exploratory approach. A case study strategy of five firms was selected in order to investigate potential similarities and differences within the cases. We further explored the QC's factors and the effect on SCM across the cases. Archival material and non-participant observation were also used. Interviewer-administered questionnaires are followed in order to support qualitative findings, providing quantitative evidence related to the effect of QC on SCM (Saunders *et al.*, 2007). This research applied triangulation as a corroboratory mode to ensure findings are more convincing and involved multiple sources of data collection and analysis to prevent subjective bias (Miles and Huberman, 1994).

This research was carried out in the context of the fruit and vegetable export chain in Jordan. This context has proven to be well-suited to the study of supply chains and QC (e.g. Martinez and Poole, 2004; Van-Der-Vorst *et al.*, 2007; Mikkola, 2008). This research has focused on different chain members, and similar to other developing markets, Jordanian fruit and vegetable exporting, particularly to the European Union, has increased and there is potential for further increase (MoA, 2012).

Data was collected via semi-structured interviews conducted with the five firms in Amman in 2011. Observations were also made by attending meetings and field tours with various managers. Archival records were examined using annual reports, proposals, and company web sites.

According to Perry (1998), “the widest accepted range for case studies falls between 2 to 4 as a minimum and 10, 12 or 15 as a maximum”. The sample units need to cover the object of interest and its context, thus to yield a larger number of potentially relevant variables (Yin, 2007). The selected firms represent various members in the supply chain, including two producer firms (Cases A and B), an exporter firm (Case C), a logistic service firm (Case D) and an importer agent firm (Case E) (the Appendix, Table AI). Targeted firms are involved in the fruit and vegetable industry and supply high quality fruit and vegetables. A non-probability sampling was adopted using a self-selection technique, based on the researcher's subjective judgment and the researcher's experience. The sample size can be considered appropriate, based on selecting the five firms to have high response rates and replication logic to validate and cross-check the information and explore themes within the industry (Harland, 1996; Perry, 1998). The five firms apply the requirements of QC in the supply chain.

Interviews helped to probe beyond initial responses and overcome unwillingness to answer particular questions (Yin, 2007). Interviews were the primary data collection method and included open-ended questions only. General managers, production managers, marketing managers, logistic managers, and importing managers responded to the interviews. Interviews covered information regarding the interviewee positions, the firm, the fresh food supply chain and the factors of QC. The process was iterative, moving backward and forward in time, exploring what their supply chain was like before the QC system, how and why they started to change

Table II Definitions of factors of QC in the SCM

Key themes "factor"	Definition	Supporting research
Commitment	A willingness of the supply chain members to put effort and resources into their trusting business	Parker <i>et al.</i> (2006); Van-Der-Vorst <i>et al.</i> (2007)
Communication	A means of information exchange between the supply chain members, involving social and technical modes, about activities and transactions of their business	Wilson (1995)
Product quality	Specification related to the product supplied between the chain members, including standards, safety issues, internal and external criteria	Faria-Fernandes <i>et al.</i> (2009)
Information quality	Specification related to the information shared between the chain members, including information content, sources, exchange methods, and value	Chopra and Meindl (2001)
Continuity	It is frequent interactions between chain members, offering advantages to their business	Celaya <i>et al.</i> (2007)
Satisfaction	The degree to which the transaction meets the business performance expectations and chain members capture both the economic and non-economic aspects of the exchange	Carnignani (2009); Talib <i>et al.</i> (2011)
Leadership	The ability of a chain member to direct the supply chain for better business and performance	Talib <i>et al.</i> (2011)
Training	A set of skills and knowledge is provided to chain members to support them in doing their functions and achieving their goals	Mavondo and Rodrigo (2001)
Environment factors	They include external (e.g. issue outside the country: policies and technology) and internal (e.g. the country's issues: country infrastructure and marketing research) environments that influence the chain members regarding their relationships	Salomon and Shaver (2005)
Policy making	A group of regulations formulated to provide headlines and guidelines for chain members	Baird <i>et al.</i> (2011)
Quality protocol	A set of control processes for chain members, from which they can reasonably state that their product and service have been fully supplied	Vladimirov (2011)
Personal relationship	A relation between people in a chain, seen as a prerequisite for most information and business exchanges	Poppo and Zenger (2002)
Financial support	Financial resources provided to chain members to make their business possible	Flynn <i>et al.</i> (1994)

and what they could have done differently in their business. All interviews were tape-recorded in order to facilitate data analysis. Follow-up telephone interviews were undertaken for further clarification.

Perry (1998, p. 796) concludes that "prior theory from the literature review and convergent interviews are linked to the cases through practices of data collection and analysis". Using the transcripts, categorising key dimensions of associations and summarising are also strategies to analyse the data (Saunders *et al.*, 2007). Moreover, "a thematic analysis can be aided by and presented as thematic networks that summarize the key themes constituting a piece of text" (Attride-Stirling, 2001, p. 386). The interviews were analysed and divided into pattern codes and themes related to the overarching theme, QC. Following Miles and Huberman (1994), the first step of our data analysis was that the interview transcripts and other sources were analysed using coding for data reduction and data displays for each case study. Coding followed an initial list of codes and was developed based on the categories that emerged as relevant from the literature review. In each case, the selected themes are refined further into themes that are specific to be non-repetitive and a manageable set of significant themes. The results of each case study will be reported in terms of the key themes and key quotes. Each completed case write-up was made available to the firm's management to share comments related to the findings in order to ensure content validity and research reliability. The second step involved cross-case comparisons of data exploration resulting in first-order concepts, consolidating categories into second-order themes, identifying aggregate dimensions underlying research theoretical categories and

examining how these might relate to each other (Figure 1). We compared codings, resulting in an intercoder agreement of $k = 0.81$ (Cohen, 1960). Using cross-case analysis techniques, the first author looked for similar themes and links across case studies and drew on extant literature to refine our understandings. To assess reliability, the other authors provided an outsider perspective. These insights justified the development of a conceptual framework linking key factors in a holistic manner.

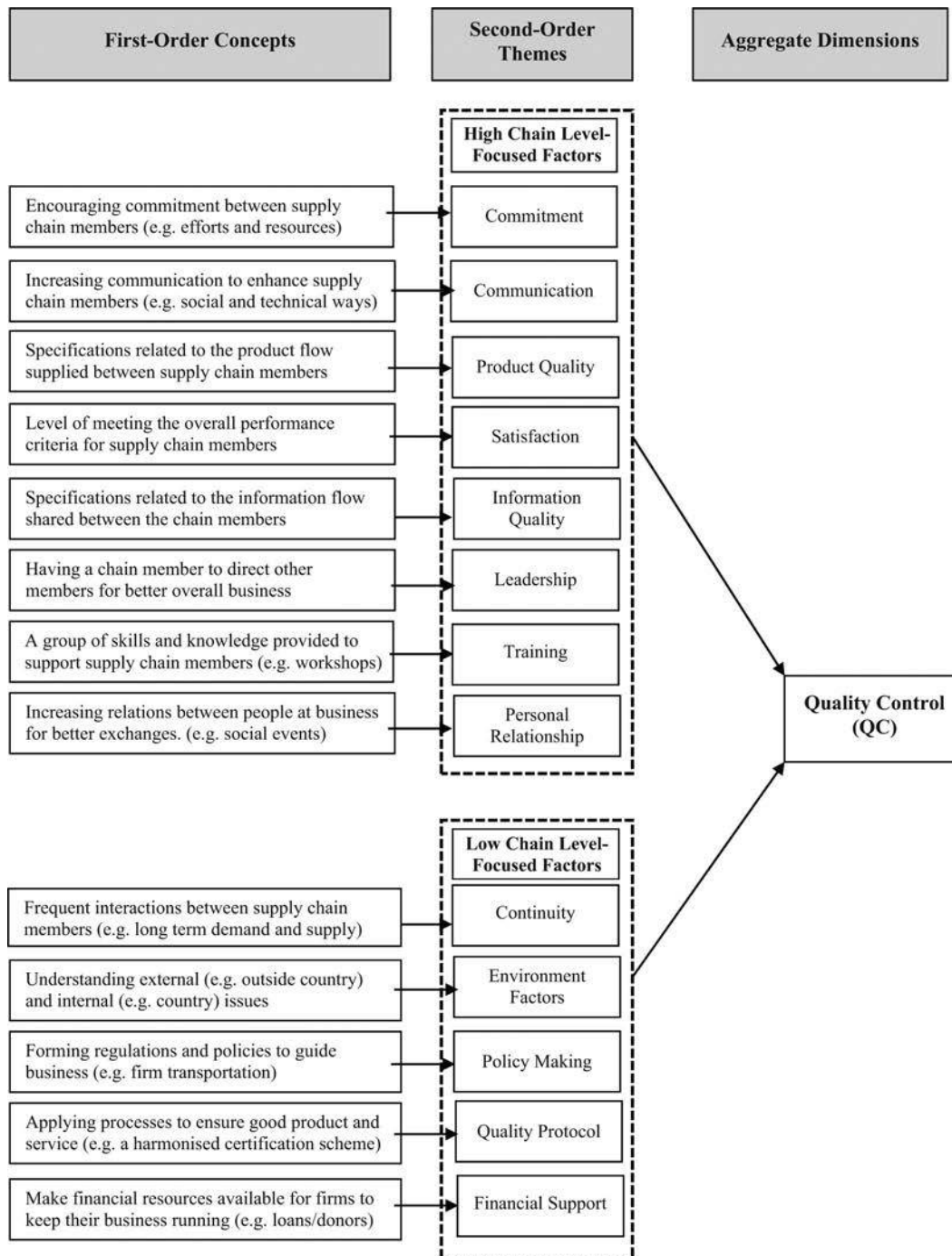
Next, questionnaires were made with a random sample of supply chain members in Jordanian fruit and vegetable industry in 2012. General managers from 60 firms (15 producers; 15 exporters; 15 logistic service firms; and 15 importer agent firms) were selected as they are usually considered main points of interaction with their supply chain's members. The questionnaire included three sections. Section (1) examines the significance of each of the QC factors in improving SCM. Section (2) identifies QC factors most recognised/applied for improving SCM at present time. Section (3) determines QC factors that should be applied in future. Interviewer-administered questionnaires were used for two main reasons. First, to ensure that the information provided by respondents will be used for the purpose of this research only. Second, to increase response rate.

4. Findings and discussion

4.1 Case studies

Case A

This case shows the importance of the factors of QC at the production level. Respondents from the producer firm

Figure 1 Comparative case data structure: high/low chain level-focused factors of QC in the SCM

explained how they understood QC in terms of product quality, communication, staff training and satisfaction in order to co-operate better with their partners, such as exporters. The informants believed that they should focus on QC in order to improve SCM. The general manager explained:

...that quality control is a key factor between supply chain members of our industry ...many elements are required to manage and control our business; these are product quality, workshops, and training for our labourers and management, and good communication with our exporters.

As such, the producer has chosen to explain his relationship with the exporter firm, providing information related to QC's agreements. Therefore, the general manager informed the exporter that they would be grateful if both could keep the same level of QC. In fact, the producer firm has complied with the exporter's product specification and the general manager was a leader in the export chain. As a result the producer firm kept all of its customers and high demand, and it was strengthened as a highly committed firm.

This case illustrates how positive feelings were created from the agreements of informants of the producer firm to keep good QC with the supply chain members, mainly the exporter firms. The producer got back to their exporters and logistical firms because they were satisfied and wanted to continue their business relationships. The producer firm took positive and effective action in relation to listing most of the high quality products supplied to their customers, who provided the producer correct and timely information related to their demand. The reflections of the producer suggest that good communication and contracting had a part to play in their reaction in terms of providing pioneering QC at their firm to the supply chain they were involved with during the previous years. Generally, identifying these variables is consistent with the research of Romano and Vinelli (2001), Carmignani (2009), Baird *et al.* (2011), which identifies high product quality, information quality, contracting and communication as major variables.

Case B

The case reflects different criteria and requirements of QC. The producer highlighted how they focused on understanding their internal environment, including customers, input suppliers, distribution channels, infrastructure, and logistic facilities. There was also focus on developing commitment, providing staff training, and encouraging financial support. The general manager stated:

...we need to improve our organisation by improving business relationships, quality standards, training, and logistic and exporting information... we also need to improve the supply chain in order to work better with other members.

Many factors of QC were found to be applied in this case. For example, one advantage of developing commitment, communication and personal relationship between staff is that it improves interaction and coordination among them which subsequently reflects on better QC application and continuity. It was also noticed that understanding different product and information quality factors at the producer firm influences the general manager in making right and timely decisions and to make agreements with input suppliers or exporters. For instance, the scheduling of a production plan is dependent on good training for staff (e.g. training on product quality and ways of communication) and good firm quality protocol (applying protocols, such as EurepGap and HACCP) that could lead the firm for better financial performance.

However, the producer explained that management was not satisfied with the formulation of policies and standards imposed by the state. The production manager of the producer firm explained that:

[...] we don't prefer to work with other chain members in all times and under all circumstances... we do not prefer to share all of our information... we prefer to operate at a firm level at first... commitment, communications, product and information quality, technical and financial support, and improving policy making are applied and improved internally first... in later stages, the whole supply chain will be considered...

The findings suggest that commitment, communication, and product and information quality, supports, and policy making are important at a firm level. This finding is consistent with the findings of Van-Der-Vorst *et al.* (2007), Duffy (2008), and Zhang and Chen (2011).

Case C

This case highlights the problems that might arise when the product quality plays a role among chain members, including importer, exporter, and producer. Both the exporter and the producer aimed at supplying high quality products. However, lack of communications and incorrect information sharing resulted in supplying products without the correct and relevant standards. The producer perceived that the problem was the exporter's responsibility and as such the producer demanded the exporter's financial support for the resolution of the problem, whereas the exporter engaged in a conflict situation with the importer.

A situation in which the exporter perceived that the main reason behind the loss of the importer was that the buyer was favoured by their competitor and therefore had developed a better personal relationship and communications. The general manager explained that "the importer has developed a good relationship based on their new personal relationship with others". The findings support the view that the preferential treatment to individual customers in the form of personal invitations, business dinners, gifts or other benefits can affect the business relationship and agreements (e.g. contract farming). This case is concerned with the provision of well trained staff, product quality and high trust that can make greater social bonding and business commitment in sharing information and experiences (Matear *et al.*, 2000).

In this case, it is notable that most of the factors of QC were initially applied as efficient expediciencies for multiple purposes. For example, one perceived advantage of developing commitment with the importer is that it helps the exporter to link business for a long-term partnership and to establish continuity based on high product quality and on-time information sharing (information about quantities, quality, time, etc.). Another notable issue is that the use of different quality control factors is mainly influenced by different members' relationships (e.g. producer, policy makers and importers), which can affect the exporter decisions and the right way of sharing information and business with others. For example, the scheduling of an exporting plan is dependent on the importer's need for a specific quantity, quality and delivery time and at the same time it is based on the producer's ability to provide the exact order asked for by the exporter. These are the main issues that should be understood in the supply chain where many factors of QC can affect the importer-exporter-producer relationships.

Case D

This case shows that managing the relationship quality between producers, exporters and importer agent firms will subsequently improve QC. The logistic service firm described how they worked with other firms and conducted joint training in order to improve relationships. They focused on social networks to get close to their customers in order to understand their needs and logistic requirements. The general manager stated:

[...] indeed, we should strengthen our personal relationship with other partners. This can be considered a wise strategy to sustain our long-term survival.

The logistic firm decided to organise a social event for customers in order to create a warm and friendly environment. During the event, the exporter complained to the producer and logistical manager about the application of

quality standards (e.g. HACCP). However, the exporter found out that all chain members were unhappy with the application of quality standards and product specifications. This was a result of hiring untrained people who applied quality information and requirements incorrectly. The sales manager of the logistic firm explained the situation to the chain members by stating that:

I understand that miscommunications and incorrect information sharing might cause many problems... we need to develop information sharing and training.

It was clear that the logistic firm did not focus on doing business with others only, but also on building better relations which can provide better business environment.

It is the right time to work as a team in order to build better relationships between producers and exporters through good communications and information exchange. We are looking to have better performance in the chain... (General Manager, Logistic Service Firm).

This case also highlighted the importance of customer satisfaction and other QC factors, such as two-way commitment (e.g. producers-logistical firm-exporters), quality information, quality protocol, financial support, and policy making. This will help the logistic firm to make better arrangements with its customers in order to organise the export supply chain more effectively. The results suggest that commitment and quality information are important to supply chain quality. This is consistent with the findings of Matear *et al.* (2000), Van-Der-Vorst *et al.* (2007), Duffy (2008), and Zuniga-Arias *et al.* (2009). Commitment is essential when products are modified for exporting and when information sharing is considered critical (Matear *et al.*, 2000). Modern practice of quality management has focused on information sharing and maintained statistical tools as an essential facet of the management of QC in the supply chain (Tapiero, 2007).

Case E

The firm was the final destination to receive the products from Jordan. As the general manager reported "we, as importing agent, are a key to reach the international customers who should be satisfied to the maximum". It was also argued that the importing agent might have had a better personal relationship and commitment with the exporters and for this reason the producers were building a strong relationship with their exporters – "the importing agent was close and friendly to the exporters more than the producers, and this is what can be understood as leadership". The general manager of the importing agency suggested that they were able to be fair towards their customers and their personal relationship may affect their decision-making in relation to improving the Jordanian supply chain and its performance.

It is notable that many QC factors were employed as high-order factors for improving the importer agent firm and export supply chain. This is consistent with Martinez and Poole (2004), and Van-Der-Vorst *et al.* (2007), who argued that food supply chain members require specific standards, such as quality standards, information protocol, financial support, contracting models, leadership and commitment in order to have a better position in their markets. For example, one advantage of better management among the supply chain is the use of a comprehensive commitment strategy between all the members in order to gain competitiveness in both cost and quality (e.g. product and information quality). Moreover, this strategy has the potential to trigger another strategy for financial support between chain members. Another notable

point is that the external and internal environment factors are key elements which can affect the procedures of applying QC in the supply chain. For example, the scheduling of an exporting plan is dependent on the internal factors (e.g. firm size and leadership) and the external factors (e.g. external policy and competition) in order to link supply and demand (Cadilhon *et al.*, 2003). The general manager reported:

Commitment, financial support, leadership, exporting environment are strong requirements that should be exist between chain members in order to improve our exporting system... I believe that if we sustain these factors in our firm and with other firms we can make better performance...

This case helps to make claims about the factors which can be crucial to the development of SCM. This case supported the idea that the flow of product and information among the chain members (producer-exporter-importer firms) should be controlled by quality standards and policies. This supports the view of Jarosz (2000), who has found that good cooperation brings about trust, resource sharing and information linkages between suppliers, retailers and consumers in the whole fresh product chain. It is also between those who have found a positive effect from information sharing, personal relationships and social bonds on the maintenance of buyer-seller relationships (Wilson, 1995; Poppo and Zenger, 2002).

4.1.2 Comparative case study

The five firms regarded QC factors to be of high importance in SCM. This is due to the fact that firms have adopted the high-order factors of QC at the firm level and supply chain level. These firms seemed to understand the importance of QC factors, but lack adequate understanding of how to apply these factors in their supply chain of fresh fruit and vegetables.

This research further examination of QC factors across the five cases revealed two primary patterns. First, the research has identified that the factors of QC were in most cases high chain level-focused, while in some other cases, were low chain level-focused. Second, it has identified an effect on SCM.

In cases A, B, C, D and E, most of QC factors showed high chain level-focused. Firms (chain members) reported that they need QC in order to improve fruit and vegetable SCM through good communications, quality standards, quality information, regulations and training. However, in cases A and B, where some QC factors were low chain level-focused, they focused more on their own firms in terms of their own standards, product quality at firm-gate level, staff training and internal environmental factors (Table III).

The findings of cross-analysis suggest that these firms should pay more attention to the factors of QC and their relationships. Factors, such as commitment, communication, product quality, satisfaction, information quality, leadership, personal relationships and training emphasise the role of QC in managing the supply chain and developing better links between producers, exporters, logistical firms and importers. The cross-analysis identifies more important key factors which can improve the supply chain. These include internal and external environment factors, policy making, quality protocol, continuity and financial support.

The findings suggest that the key factors (second-order themes) identified are grouped to be linked to QC as an overarching factor (aggregate dimension) in order to develop a holistic conceptual framework. This framework will highlight important themes that need further explorations.

Table IV Factors of QC in the cases: cross-case comparisons

Factors of QC in SCM	
Case	Low chain level-focused
A	<p>"Commitment is a great thing, it is what we want to keep in all our chain to have good trust among the fresh chain members... it makes us willing to spend more efforts to bring better quality for all" (General Manager, Producer 1)</p> <p>" . . . good commitment and communication with all chain members are our key to make better control for both product and information flows" (General Manager, Producer 2)</p>
B	<p>" . . . this is what we want in the chain as whole and not just for our firm . . . good communication across the chain members including social meetings, good technology and networking.. the more we communicate the more we can share good ideas for good quality criteria" (Production Manager, Producer 1)</p> <p>" . . . we think about both our firm and the chain. . . we have good commitment of trust and resources and good understanding for our internal environmental factors at our firm . . . it is good for high quality control We prefer to have the same at the chain where we are involved to supply our fresh products" (General Manager, Producer 2)</p>
C	<p>"we agree with our producers that business personal relationships and leadership are key factors to keep better control for chain and product quality in Jordanian fresh fruit and vegetable industry" (Marketing Manager, Exporter)</p> <p>"the more we train and financially satisfy our chain members, the more we control the quality and have better performance" (Sales Manager, Logistical Service Firm)</p>
D	<p>"it is better to have good product and information quality among the chain members, which means the whole QC is better in the chain" (General Manager, Logistical Service Firm)</p> <p>"Always, we create good personal relationships with producers and exporters, which lead them to work together on good quality for products and information across the chain members. We depend on the good training also " (General Manager, Importer Agent Firm)</p>
E	<p>"What we focus on is what we think will lead our production level to better match the customer needs...customer continuity, quality protocol, more financial support and good practice information aren't very effective now but they are very important for our future" (Production Manager, Producer 1)</p> <p>"We don't care to much for what others in the chain do to have good product quality. . . we focus just on providing high quality products from our firm following government regulations. . . . it is the way to have better quality control and last longer in this business" (Production Manager, Producer 2)</p>

These themes of QC will arise new issues to study how supply chain members might choose a set of these themes to cooperate and coordinate in more practical ways concerning fresh produce industry in order to minimize transaction costs, increase customer satisfaction and maximize profits. For example, chain members should choose to set customer expectation by announcing their maximal delivery-time. This issue highlights how a firm might choose a delivery-time commitment to affect its delivery quality in order to maximize its market share. Therefore, this research is driven by the assumption that if the management understands the importance of grouping factors of QC, they are more likely to improve their export SCM and reach international markets. The study has generated several themes related to the aggregate dimension and the research topic. Figure 2 shows the 13 factors of QC in SCM.

4.1.3 Questionnaires

A total of 60 questionnaires were returned, which were deemed usable, resulting in a full response rate. Investigating current and future trends is important as it sheds a light on the development of QC understanding and acceptance within the fresh fruit and vegetable industry in Jordan. It also provides future researchers with a better recognition of QC factors expected to be applied in future and which can be subject to further investigation.

Section (1): Expected level of significance of each of the QC factors on SCM: In order to examine the significance of each of the 13 QC factors, respondents were required, on a five-point Likert Scale, where 1 stood for “not significant” and 5 stood for “very significant” to indicate how significant these factors were. F1 = commitment; F2 = communications;

F3 = product quality; F4 = continuity; F5 = satisfaction; F6 = information quality; F7 = leadership; F8 = training; F9 = environment factors; F10 = policy making; F11 = quality protocol; F12 = personal relationship; F13 = financial support.

Figure 3 shows the average level of significance of each of the QC factors in improving SCM. The respondents believe that communications, product quality, continuity, training, and financial support are significant/very significant for improving SCM.

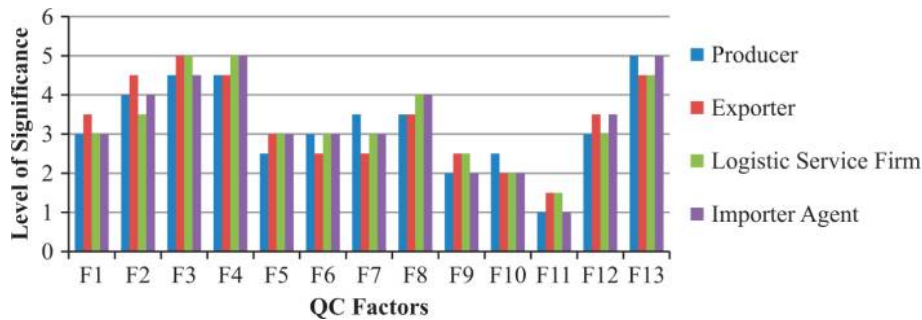
Section (2): QC factors most recognised/applied for improving SCM at present time: Respondents were asked to identify the QC factors they believe are most recognised/applied for improving SCM at the present time. Figure 4 shows that these factors are: commitment, communications, product quality, satisfaction, leadership, training, and personal relationships.

Section (3): QC factors that should be taken into consideration in future in order to improve SCM: Respondents were asked to identify the QC factors they believe are most important for improving SCM in future. Figure 5 shows that these factors are: continuity, environment factors, policy making, quality protocol, and financial support.

Previous studies failed to evaluate comprehensively the impact of QC on SCM and did not identify the factors of QC required for the fresh fruit and vegetable supply chain. Most of the past research examined one member of the supply chain only. This paper provides a theoretical link between the high-order themes and the overarching theme, QC, in a holistic framework. It is a causal model that offers a higher

Figure 2 Conceptual framework: factors of QC in SCM



Figure 3 Expected level of influence of each of the 13 QC factors on SCM

order effort to derive a set of theoretical links about a more comprehensive network of factors and interrelationships (Miles and Huberman, 1994). This research is based on theory building for a new framework (Miles and Huberman, 1994).

5. Conclusion and contributions

QC in SCM can be adopted by upstream suppliers (e.g. producers, exporters), downstream customers (e.g. exporters, importers), or logistic service firms. In today's volatile market environment, QC is perceived to be an important competitive priority and marketing tool. The current research has examined the QC that supply chain players adopt in response to various perceived export marketing requirements. Thirteen factors of QC were identified and explored according to their capacity to improve SCM.

Most of the QC's factors were examined and refined in relation to the way in which they are applied in SCM. This research indicates the importance of firms adopting a QC's strategy for present and future development in their SCM. Prior to making decisions on the supply chain strategy for exporting, firms must undertake a careful and full analysis of the characteristics and importance of QC's factors. More importantly, firms that are coping with highly specific business requirements of quality, standards, delivery time and customer satisfaction need to be more connected to other chain members and to enable their managers to adopt the QC's path; otherwise, they may be unable to survive intense market competition or have a better overall chain performance. If a balance between chain players is achieved, further achievements and developments can be considered, for instance, an integrated framework for QC in the SCM. This

framework can serve as a guide for the firms and policy makers.

This research contributes to the supply chain literature in two ways. First, it expands on the previous approach of treating a single firm as a complete system by considering integration within the supply chain level and the involvement of producers, exporters, logistic providers and importers. This will strengthen the theoretical foundation required for the supply chain and the ties with QC. Second, this research employs an exploratory approach to identify QC factors. A standardised instrument to measure the dimensions of QC is expected to be developed on the basis of this research in order to form and examine useable propositions for better research findings.

This research identifies 13 factors of QC. Strategic measures to promote these dimensions require interaction and co-operation among firms' departments and among supply chain members. The identified framework for QC's factors in SCM can assist top managers in viewing and applying these factors effectively. Second, this improved understanding of QC and the proposed framework will assist supply chain managers to strategically facilitate a dynamic flow of products, information and resources to support their activities and co-operation.

This study has identified many issues that can be explored by future researchers. Future trends of QC in SCM are highly recommended. The variety of activities in supply chains, the perishable products, the number of chain members and the uncertainties of export markets all indicate that QC need to be integrated with SCM. Integrating QC and SCM will improve the financial and managerial aspects of supply chain performance. This research has highlighted the importance of information and product quality in the fresh fruit and vegetable supply chain. Further research is needed to identify

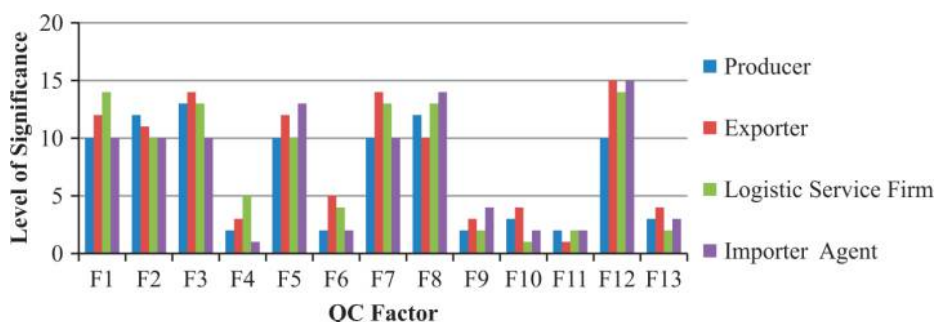
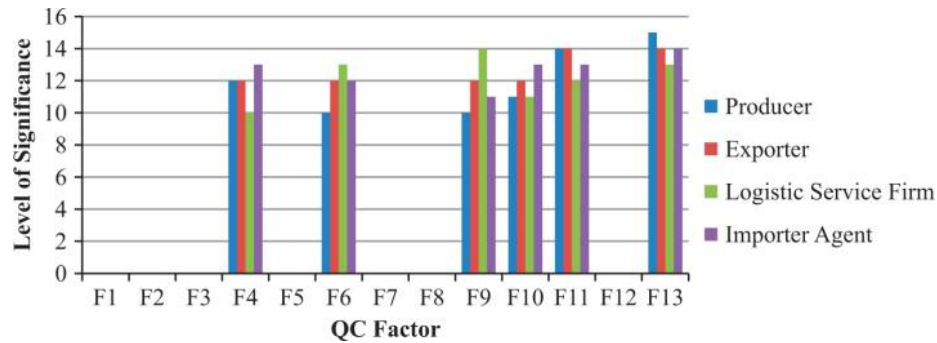
Figure 4 QC factors most important for improving SCM at the present time

Figure 5 QC Factors that should be considered in future to improve SCM

major elements of information and product quality and how to increase information and product flow among the supply chain members. Future research is also required to focus on issues of quality expectations related to delivery (i.e time, quantity, and delivery mode). A product flow between the supply chain members needs to be analysed to capture the impact of delivery quality on the QC system and the impact of the information flow on product delivery quality. There is a need to explore how firms aim to reduce distribution uncertainties among chain members in order to increase their chances of obtaining more dependable deliveries with a minimum amount of “just-in-case” resources such as materials inventory, safety production capacity and labour overtime.

Further empirical work is required on how dyadic relationships between upstream and downstream chain members have evolved and the critical factors that will guarantee the creation of QC among the chain members. In addition, further research is needed in determining how chain members can make better use of the factors in QC when establishing, developing, maintaining and terminating dyadic relationships that deliver commercial benefits, which in turn will support the continuation of strong, positive relationships – a virtuous cycle of sustainable relationships between chain members and the whole supply chain. Another research direction could be based on relationships that have terminated and the identification of the relative importance of the factors that might contribute to restoring these relationships. Future research is required to break down the factors of QC in more depth and in order to determine which factors are more or less influential.

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Appendix

Table A1 Overview of the cases

Case	Type of business	Location	Year established	Years of experience	Firm size	Number of employees	Tonnes/year	Export to European Union tonnes/year
A	Producer	Jordan Valley	1985	25	Large	30	2,000	400
B	Producer	Highlands	1990	20	Medium	25	1,000	100
C	Exporter	Amman	1995	15	Large	15	2,000	500
D	Logistical service firm	Amman	1997	15	Large	20	N/A	1,500
E	Importer agent	Amman	2000	10	Medium	10	1,000	1,000

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