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The Relationship between IT and Supply Chain Performance: A Systematic Review and Future Research

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Abstract

Many firms have spent large investments in developing and implementing information technologies and systems to enhance their supply chain performance with little benefit, while others have spent similar amount of money with great success [1]. The IT productivity paradox in supply chain performance is widely cited as a polemic that needs more investigation. This work reviews the body of knowledge related to the relationship between IT and supply chain performance through a systematic literature review study, following a pre-defined search protocol that can be used by other researchers to review other subjects in the area of information technology, to provide an overview of the state of the art and identify research challenges and gaps. 33 papers are finally selected, in which three main themes of research, nineteen IT-relates characteristics, and seventeen mediator factors to enhance supply chain performance are identified. The indirect effect of IT in SCP is the major findings in the literature. This work presents some new guidelines of research.

Keywords

Information Technology, Supply Chain Performance, Systematic Literature Review

1. Introduction

Nowadays, firms are seeking to have more advantages that can enable competitive differentiation, and allow them to acquire and maintain a competitive position in a competitive environment.

On the other hand, the huge advancement of Supply Chain Management Practices and logistic research has resulted in the change of nature of competition in business from company-to-company to supply chain-to-

supply chain [2]. In Supply Chain to Supply Chain economies, the performance of supply chain management is an important determinant of firm's competitiveness.

That's why this topic has received increasing attention from both researchers and practitioners, which have tried to link supply chain performance with other firm's capabilities and resources.

Information Technology is defined as a critical factor to enhance the supply chain performance, and the huge advances in information technology over the past two decades enabled the emergence of modern supply chain management [3], with its power to provide timely, accurate, and reliable information [4], to enhance collaboration and integration between partners, and to improve the agility and flexibility of both the focal firm and the partners in the supply chain.

The positive effects of IT on supply chains' performance have been approved by many researchers [5], while other researchers indicated that there was no real consensus about how that maintenance of competitive advantage was related to IT capabilities [6], this phenomenon is widely cited in the literature as the productivity paradox in information technology.

As the research area of IT productivity in supply chain performance matures and the number of related studies increases, it is important to review and analyze related works to provide an overview of their research issues, and their findings, to systematically identify research challenges and gaps that require more attention from both researchers and practitioners.

This work presents the results of a systematic literature review on the relationship between IT and supply chain performance in research works published from January 2000 to February 2014. The remainder of this paper is outlined as follow. A definition of supply chain performance is outlined in Section 2, and the review methodology is presented in Section 3. Section 4 presents the results of this SLR, and the future directions are presented in Section 5.

2. Supply Chain Performance Management

The area of the supply chain management has become one of the man perquisites of the competitive advantage in companies, and the emphasis now is how a group of firms in the same supply chain can perform to satisfy needs and create value to the final customer.

Manufacturing firms face the problem of how to provide efficient and cost-effective response to gain advantages in the changing environment. Uncertainties including complicated production processes, random yields, and high quality requirements and so on all affect their supply chain performance [7].

The results of the major international survey of supply chain performance conducted by a Harrison and C. New [8] reported that 93% of the surveyed firms confirmed the very important role of the supply chain performance in achieving competitive advantage.

Numerous ways have been defined in the literature to describe the performance in the supply chain, and to help design a role model or strategy to effectively operate complex supply chain for firms [7].

One of the most common definitions of the supply chain performance is that proposed by M. Subramani [9] defined as the extent to which the firm receiving the following benefits as a result of its relationship with partners: cost efficiencies from higher sales volumes, improvements to current processes or creation of new processes and increased profitability.

Forslund and Jonsson [10] considered the supply chain performance Management as a process which is defined as consisting of five main activities: selecting performance variables, defining metrics, target setting, measurement and analysis.

Performance measurement is still a hyper-topic in the Supply Chain Performance Management (SCPM). A lot of frameworks have been established by researchers modeling supply chain, examining factors that may influence supply chain performance and identifying performance variables. One of the major factors cited in the literature is the Information Technology (IT). The IT productivity in the supply chain performance context and the importance of IT to support supply chain performance are repeatedly cited in the literature.

This paper seeks to assess the different aspects of the relationship between information technology and performance of the supply chain.

3. The Review Methodology

The objective of this section is to describe the research methodology and to explain how data was collected and

how results was obtained and analyzed. Systematic Literature Review (SLR) has been utilized as the research method for this paper.

A systematic literature review is a systematic, explicit, comprehensive and reproducible method [11] to identify, appraise, and synthesize all available research relevant to a particular research question, or topic area, or phenomenon of interest, which may represent the best available evidence of a subject [12].

The need and value of conducting Systematic Literature Review for IT and Supply Chain Management has been appreciated in the literature by a reasonable amount of research projects, as detailed in [11] [13] and [14], and the reasons for performing a Systematic Literature Review in our case are to identify, classify, summarize and analyze the progress of research in the relationship between IT and Supply chain performance, to identify gaps and suggest areas for further investigation and to provide a context to justify new research project.

The major guidelines of performing a SLR in this study are drawn primarily from two studies: [11]'s guide to Conducting a systematic Literature Review of Information Systems Research and [14] article on Systematic Literature Review in Management and Organization Science.

These guidelines establish that SLR should comprise four phases: Planning, Selection, Extraction and Execution as illustrated in **Figure 1**, with eight major steps. These steps are iterative and will be executed until the target level of analysis is reached.
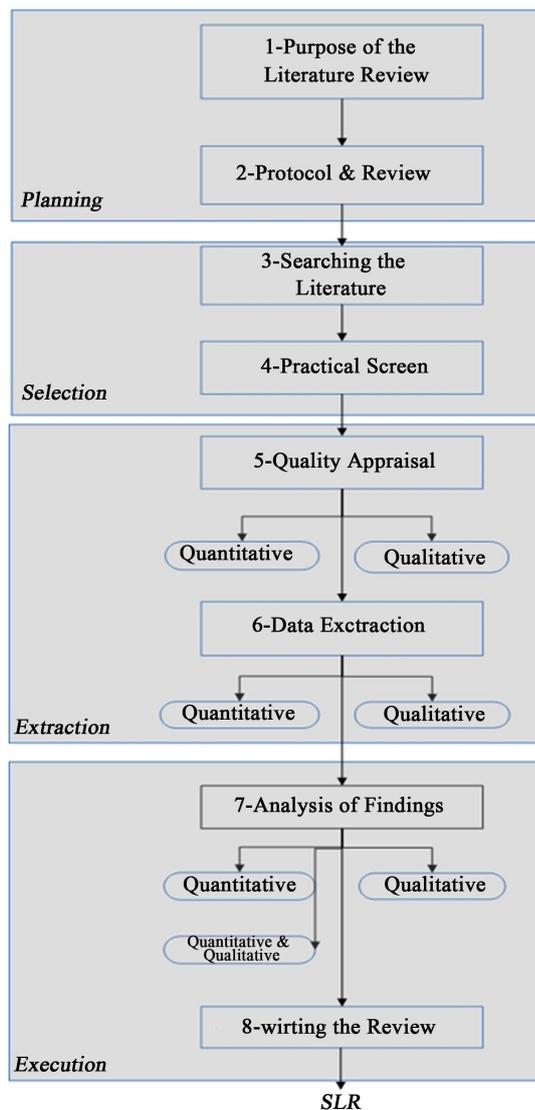

Figure 1. A systematic guide to literature review development (Adapted from [11]).

The first step is to identify the purpose and intended goals of the review, then to prepare a detailed protocol and training for all reviewers to ensure consistency in the execution of the review [11].

In the steps 3, 4 and 5, a detailed description of the literature research, inclusion and exclusion criteria, and quality appraisal to ensure that just articles with high quality were accepted. After all, all included papers must be examined to extract all relevant data, to be synthesized using quantitative and qualitative techniques. The result of all the process must be documented with sufficient data to be easily and independently reproduced [11].

3.1. Research Questions

Defining the IT productivity in the Supply chain and its influences in the supply chain performance is not a new research problem. Over the years, different approaches and models have been introduced in the literature to explain this relationship between IT and supply chain performance. To understand existing research in this area, the following research questions are formulated:

RQ1: How does IT impact Supply Chain Performance?

Rationale: Answering this research question can help identify different forms of the IT impact in the supply chain performance.

RQ2: What are the different aspects of this relationship that have been cited in the literature?

Rationale: Answering this research question can help identify the different aspects of the IT impact on SCP: positive or negative, direct or indirect.

RQ3: What research has been performing in the relation between IT and SCP?

Rationale: This question aims to locate and catalog the research studies have been performed to understand the relationship between IT and SCP.

RQ4: What findings can be drawn from existing studies?

Rationale: Answers to this research question can help to identify the gaps and suggest areas for further investigation in the relationship between IT and SCP.

3.2. Source and Search Keywords Selection

To find relevant studies which are located at the intersection of supply chain, IT, Performance Measurement, an in-depth evaluation has been conducted of the papers and studies in the major online search academic article search engines as illustrated in the **Table 1**.

The research was done using a list of pre-defined key words as illustrated in **Table 2**, the words used to searches are often used in the literature to describe the area of study of Information Technology (IT) and its functional roles in the Supply Chain (For example: Information systems, ERP, transaction execution, collaboration, decision support…), and other words that are used in the literature to describe Supply Chain Performance (For example: Agility, responsiveness, efficiency…).

By taking all of the above aspects into account, a search query was specifically designed in order to find relevant papers for the relationship between Information Technology and supply chain performance, by combining keywords figured below through Boolean logic as illustrated in **Table 3**.

3.3. Eligibility Criteria

The following inclusion and exclusion criteria are defined to ensure that relevant studies are included and no study is excluded without evaluation.

Inclusion criteria:

Table 1. Research engines used in the review.

Research engines
Science Direct
IEEE Xplore
Google Scholar
Wiley InterScience
CiteSeerx

Table 2. Search keywords.

Information Technology	Supply Chain Performance
Information Technology (IT)	Supply Chain Performance (SCP)
Information Systems (IS).	Supply Chain Integration.
Enterprise Resources Planning (ERP)	Supply Chain Operation.
Supply Chain Management Systems (SCMS).	Supply Chain Responsiveness.
IT capabilities	Supply Chain efficiency
Information Sharing	Supply chain effectiveness
IT services	Supply Chain Agility
Information Systems Management	Supply Chain Sustainability
IT infrastructures	Supply Chain Collaboration
Manufacturing Execution Systems (MES)	Supply Chain Reliability
Advanced Pacification and Scheduling (APS)	
IT Productivity	
IT paradox	

Table 3. Search query.

(Information Technology OR IT Information Systems OR IS OR Enterprise Resources Planning OR ERP OR Supply Chain Management Systems OR SCMS OR "IT capabilities" OR "Information Sharing" OR "IT services" OR "Information Systems Management" OR "IT infrastructures" OR "Manufacturing Execution Systems" OR "MES" OR "Advanced Pacification and Scheduling" OR "APS") AND ("Supply Chain Performance" OR SCP OR "Supply Chain Integration" OR "Supply Chain Operation" OR "Supply Chain Responsiveness" OR "Supply Chain efficiency" OR "Supply Chain Agility" OR "Supply Chain Sustainability" OR "Supply Chain Collaboration" OR "Supply Chain Reliability" OR "Competitive advantage")

I1: The theme of this study is the relationship between IT and Supply chain performance.

I2: This review covers the following topical areas:

- The impact of IT in the supply chain performance.
- The IT-related attributes in the SCP.
- The presence of IT in the supply chain performance measurement and indicators.

I3: This review target papers published between January 1, 2000 and February 20, 2014 in English.

Exclusion criteria:

E1: Any paper related to very narrow aspects is excluded.

E2: Any paper whose full text is not accessible is excluded.

E3: Any paper that was purely technical is excluded.

E4: Articles that did not match the inclusion criteria are excluded.

3.4. Search Protocol and Training:

The research protocol is considered as an important quality assurance step of a Systematic Literature Review, it serves as the road map towards answers to research questions [11].

The research protocol was drawn up in according with the [11] guidelines; the search protocol was carried out sequentially following these tree steps as shown in the **Figure 2**.

Phase 1: Gathering potential studies based on title and abstract review.

Phase 2: Application of eligibility criteria.

Phase 3: Selection studies based on full text assessment.

First of all, to identify potential primary studies, an automated and exhaustive research for papers was performed in each search engine. All relevant studies was regarded as potentially relevant and was stocked in a reference manager and academic social network (**Mendely**) to organize the selection on the basis of title and abstract.

The vast majority of studies founded in the first phase were inapplicable to the research question of this review; thus, the next two steps are the practical screen, that is, deciding which studies should even be considered for the review [11].
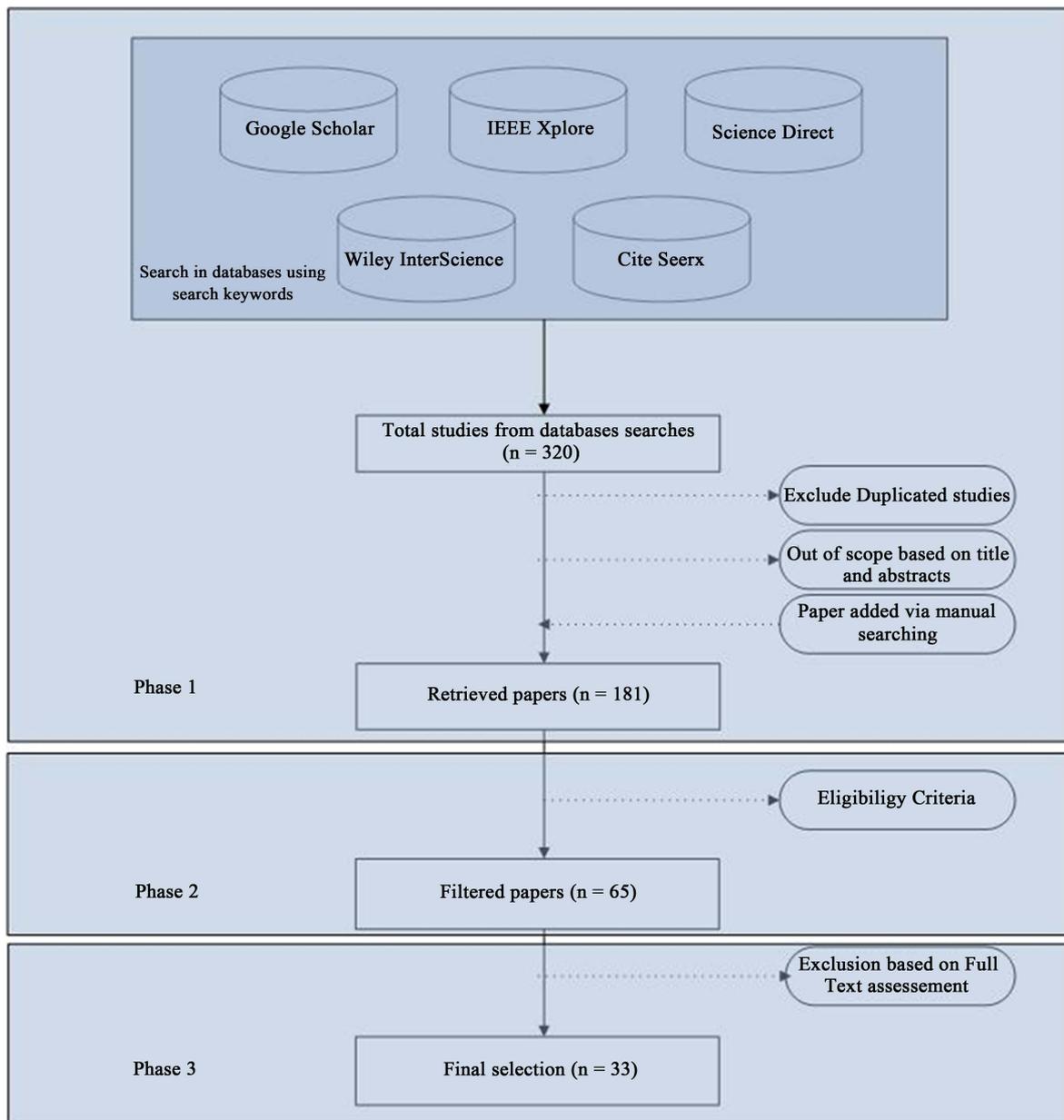
Figure 2. Search process.

The second phase of this search protocol consisted of an update on the list of primary studies, on the basis of inclusion and exclusion criteria to exclude irrelevant papers.

The final phase included assessments and reading the full-text of each remaining papers to check the selected papers that they fit to be included in the final selection.

3.5. Quality Appraisal

All potentially eligible articles have been collected; as a basis for confidence in the final results, the next step in this review was the quality appraisal to examine the papers more closely to assess their quality because the quality of the final review depends very much on the quality of the primary studies that aren't of equal quality [11].

To appraise the quality of papers that had been selected, stricter criteria had been established for which papers should continue to be considered for the final study.

This quality assessment was performed using the following quality metrics shown in **Table 4**, inspired by [13]'s recommendations.

These six criteria represent the minimum quality threshold, and just papers with 6/6 score are eligible.

3.6. Data Extraction

In this stage, the data extraction was performed using the **Mendely 1.11** to extract and manage citations and references for papers remained after the quality appraisal.

To answers the RQs defined above, specific data was extracted from the selected studies as shown in **Table 5**.

The bibliographic reference, type, aims, research methods, findings, conclusions and future research are reported to be analyzed in results section.

Table 4. Qualityappraisal.

Criteria	Response options	Quality issue
The aims of research is sufficiently explained	Yes = 1/No = 0	Rigor: to ensure the quality of the research methodology and the data collections and analysis
The research method is clearly reported	Yes = 1/No = 0	Rigor: to ensure the quality of the research methodology and the data collections and analysis
The data identification and collection is described	Yes = 1/No = 0	Rigor: to ensure the quality of the research methodology and the data collections and analysis
The method used to analyze data is clearly explained	Yes = 1/No = 0	Rigor: to ensure the quality of the research methodology and the data collections and analysis
The findings are clearly stated and provided with credible results and justified conclusions	Yes = 1/No = 0	Credibility: to ensure that the findings are valid and meaningful
The findings provided a valuable contributions to the research question	Yes = 1/No = 0	Relevance: to ensure the relevance of the study for the relationships between IT and Supply chain performance

Table 5. Data extraction from each paper.

#	Data name	Data description	Research question
D1	Paper identifier	Unique ID	All questions
D2	Year of publication	In which year was the study published?	All questions
D3	title	title	All questions
	Author	Author	All questions
	source	Academic research engines	All questions
D4	Type of paper	Journal article, conference paper, workshop paper, book section	All questions
D5	Paper aims	What were the aims of the study?	All questions
D6	Research method	What was the research method?	RQ3
D7	Definition of supply chain performance given in paper	What is the SC definition adopted in paper?	RQ1, RQ2
D8	The influence of IT in the SCP	How IT influence SCP? Positively or negatively? Directly or indirectly?	RQ1
D9	Aspects of the relationship between IT and SCP given in paper	Which aspect of the relationship between IT and SCP is introduced by the paper?	RQ2
D10	Findings and conclusions	What were the findings of the paper?	RQ4
D11	Validity	What were the limitations of the paper?	RQ4
D12	Relevance	Other research project	RQ4
D13	Future research	What were the research prospects of the paper?	RQ4

4. Results

The protocol defined earlier was executed step by step with the objective of identifying the relevant studies. In the following, the results of this systematic review are depicted, and the most important findings related to the relationship between IT and Supply Chain Performance are analyzed.

4.1. Overview of Results

After executing all stages of the research process, only 33 papers were identified as relevant papers (shown in **Table 6**) and were chosen to be analyzed in this review.

The literature had been characterized by presenting the number of publication by year, the methodology that had been applied, and the results from quality appraisal.

4.1.1. Classification by Year

All selected papers were published between 2000 and 2014, and the number of papers increases since 2011 (more than 60 % of papers were published after 2011), and the most relevant papers were found in 2013 (21%). These results can be explained by the huge advances in information technology that has already taken place in the recent years. **Table 7** shows the frequency of papers by years.

4.1.2. Classification by Research Methodology:

Figure 2 list the number, percentage of papers and an overview of the research methods reported in this review. As shown in **Table 8**, 22 (67%) of the 33 papers identified were classified as a survey and was done through questionnaires or interviews on from a large population of practitioners. however a small number of papers adopted a case-study or simulation.

4.1.3. Classification by Publication

The 33 papers were collected from 25 publication sources, 20 journals and 5 conferences. Only 5 papers were published in conferences, while 28 papers were published in journals. The top five leading venues are IJPE, IJIM, SCMIJ, IJEBMS and IEEE Tem. **Table 9** shows the frequency of selected papers by publication resource, including the source name, type, number of papers and the percentage.

4.1.4. Classification by the Research Theme

Based on the analysis of these 33 papers, all relevant studies treated three distinct research themes, but with the same objective, investigate the relationship between Information Technology (IT) and Supply Chain Performance (SCP):

- Theme 1: Mediating roles

  The Supply Chain Characteristics that serve as mediating factors between IT-related resources and supply chain performance, and "can transform IT-related resources into higher value for a Supply chain" [15] (*i.e.*, Supply Chain Agility, Supply chain flexibility).

- Theme 2: IT related resources

  The IT resources that allow companies to achieve a supply chain performance (*i.e.*, IT Skills, IT Infrastructure).

- Theme 3: Critical Success Factors

  The pertinent factors that influence the successful application of IT in Supply Chain Performance Management [16], these factors are cited in the literature as prerequisites for the successful application of IT in Supply Chain Management, and to enhance supply chain performance (*i.e.*, Education & Training, inter-organizational collaboration).

4.2. Integrative Framework

The effective understanding of the relationship between IT and Supply Chain Performance requires an integrative framework that links the three themes, because the greater amount of selected papers treated two or three themes. **Figure 3** presents the integrative framework.

Table 6. Summary of selected papers.

Paper	Title, Author
P01	Swafford, P. M., Ghosh, S., & Murthy, N. (2008). Achieving supply chain agility through IT integration and flexibility. *International Journal of Production Economics*
P02	Fu-Ren Lin, Sheng-hsiu Huang, & Sheng-cheng Lin. (2002). Effects of information sharing on supply chain performance in electronic commerce. *IEEE Transactions on Engineering Management*
P03	Ye, F., & Wang, Z. (2013). Effects of information technology alignment and information sharing on supply chain operational performance. *Computers & Industrial Engineering.*
P04	Zhang, X., & Wang, H. (2011). Empirical Research on Associations among Information Technology, Supply Chain Robustness and Supply Chain Performance. *International Journal of Business & Management.*
P05	Jin, Y., & Vonderembse, M. (2014). Exploring relationships among IT-enabled sharing capability, supply chain flexibility, and competitive performance. *International Journal of Production Economics.*
P06	Fawcett, S., & Osterhaus, P. (2007). Information sharing and supply chain performance: the role of connectivity and willingness. *Supply Chain Management: An International Journal.*
P07	Narasimhan, R., & Kim, S. W. (2001). INFORMATION SYSTEM UTILIZATION STRATEGY FOR SUPPLY CHAIN INTEGRATION. *Journal of Business Logistics.*
P08	Gunasekaran, A., & Ngai, E. W. (2004). Information systems in supply chain integration and management. *European Journal of Operational Research.*
P09	Chae, B., Yen, H., & Sheu, C. (2005). Information Technology and Supply Chain Collaboration: Mediating Effects of Existing Relationships between Partners. *IEEE Transactions on Engineering Management.*
P10	Fawcett, S. E., Wallin, C., Allred, C., Fawcett, A. M., & Magnan, G. M. (2011). Information technology as an enabler of Supply Chain Collaboration: A dynamic-capabilities perspectives. *Journal of Supply Chain Management.*
P11	Maleki, M., Davoudi, S., & Moradi, H. (2011). Information technology impact on supply chain capabilities and firm performance: A survey in Iran's manufacturing companies. *International Journal of of Research in IT, Management and Engineering.*
P12	Dong, S., Xu, S. X., & Zhu, K. X. (2009). Information Technology in Supply Chains: The Value of IT-Enabled Resources Under Competition. *Information Systems Research.*
P13	Ngai, E. W. T., Chau, D. C. K., & Chan, T. L. A. (2011). Information technology, operational, and management competencies for supply chain agility: Findings from case studies. *The Journal of Strategic Information Systems.*
P14	Lee, H., Kim, M. S., & Kim, K. K. (2014). Interorganizational information systems visibility and supply chain performance. *International Journal of Information Management.*
P15	Mohammadi, A. (2012). Investigating the effects of information technology on the capabilities and performance of the supply chain of dairy companies in Fars province: A multiple case. *African Journal of Business Management.*
P16	Forslund, H., & Jonsson, P. (2010). Selection, implementation and use of ERP systems for supply chain performance management. *Industrial Management & Data Systems*
P17	Qrunfleh, S., & Tarafdar, M. (2014). Supply chain information systems strategy: Impacts on supply chain performance and firm performance. *International Journal of Production Economics.*
P18	Singh, R., & Jayraman, V. (2013). Supply Chain Integration and Information Technology. *International Journal of Economics Business and Management Studies.*
P19	Prajogo, D., & Olhager, J. (2012). Supply chain integration and performance: The effects of long-term relationships, information technology and sharing, and logistics integration. *International Journal of Production Economics.*
P20	Egberink, J. (2013). Supply Chain Management: Horizontal collaboration and the role of Information Systems–a literature review. *18th Twente Student Conference on IT.*
P21	Gorla, N., & Scavarda, A. (2012). The Effect of IT Service Quality Attributes on Supply Chain Management and Performance. *World Academy of Science, Engineering and Technology.*
P22	Wang, J., Huang, C., & Chen, Y. (2007). The impact of alignment between supply chain strategy and IS strategy on SCM performance. *Supply Chain Management: An International Journal.*
P23	Shuai, J. J. (2007). The impact of ERP implementation on corporate supply chain performance. In 2007 *IEEE International Conference on Industrial Engineering and Engineering Management.*
P24	Ogunyemi, T., & Aktas, E. (2013). The impact of Green Information Systems on sustainable supply chain and organizational performance. 10th *European, Mediterranean & Middle Eastern Conference on Information Systems* 2013, UK.
P25	Gilaninia, S., Author, C., & Azizi, N. (2011). The Impact of Information Technology Application on Supply Chain Performance. *Interdisciplinary Journal of Contemporary Research in Business.*

Continued

P26	Wu, F., Yeniyurt, S., Kim, D., & Cavusgil, S. (2006). The impact of information technology on supply chain capabilities and firm performance: a resource-based view. *Industrial Marketing Management*.
P27	Liu, H., Ke, W., Wei, K. K., &Hua, Z. (2013). The impact of IT capabilities on firm performance: The mediating roles of absorptive capacity and supply chain agility. *Decision Support Systems*.
P28	Tang, L., Shih, C., & Hon, C. (2004). The Impact of IT Capability and E-business on the Supply Chain Performance. *The Fourth International Conference on Electronic Business* (ICEB2004).
P29	Li, G., Yang, H., Sun, L., & Sohal, A. S. (2009). The impact of IT implementation on supply chain integration and performance. *International Journal of Production Economics*.
P30	DeGroote, S. E., & Marx, T. G. (2013). The impact of IT on supply chain agility and firm performance: An empirical investigation. *International Journal of Information Management*.
P31	Liu, H., Wei, K., & Hua, Z. (2013). The Interaction Effects between Supply Chain Integration and IT Capabilities on Firm Performance. *Pacific Asia Conference on Information Systems* (PACIS).
P32	Shatat, A., & Udin, Z. (2012). The relationship between ERP system and supply chain management performance in Malaysian manufacturing companies. *Journal of Enterprise Information Management*.
P33	White, A., Daniel, E. M., & Mohdzain, M. (2005). The role of emergent information technologies and systems in enabling supply chain agility. *International Journal of Information Management*.

Table 7. Temporal distribution of the selected papers.

Year	Number of papers	%
2001	1	3%
2002	1	3%
2003	0	0%
2004	2	6%
2005	2	6%
2006	1	3%
2007	2	6%
2008	1	3%
2009	2	6%
2010	1	3%
2011	6	18%
2012	4	12%
2013	7	21%
2014	3	9%
Total	33	100%

Table 8. Research methodology in the retrieved papers.

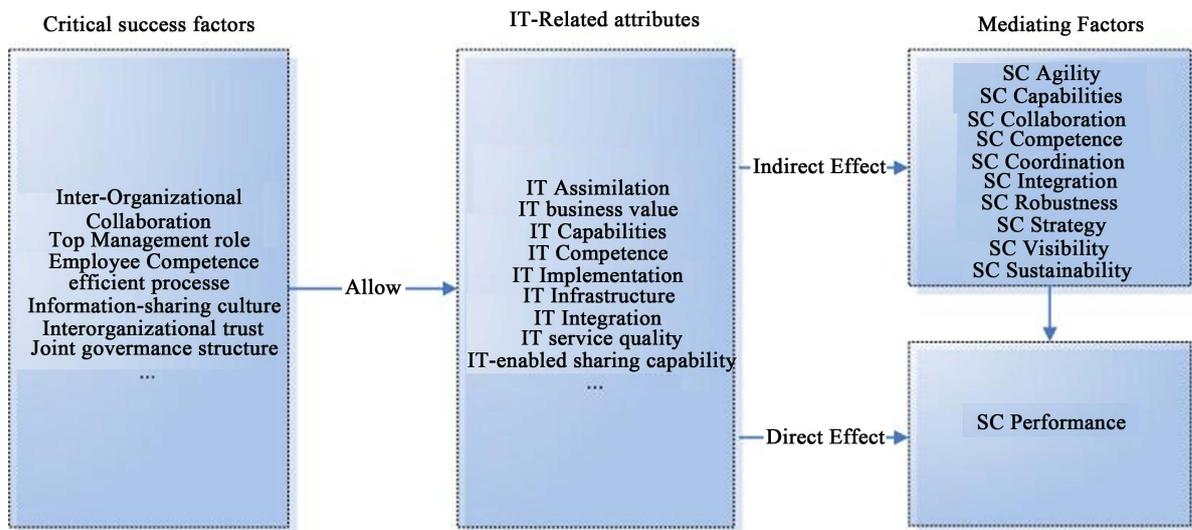| Research methodology	Number of papers	%
Mixed	3	9%
Multiple-case	4	12%
Review	2	6%
Simulation	1	3%
Single case	1	3%
Survey	22	67%
Total	33	100%

Figure 3. Integrated framework.

Table 9. Summary of selected papers by publication source.

Publication	Type	Number of papers	%
International Journal of Production Economics (IJPE)	Journal	4	12%
International Journal of Information Management (IJIM)	Journal	3	9%
Supply Chain Management: An International Journal (SCMIJ)	Journal	2	6%
International Journal of Economics Business and Management Studies (IJEBMS)	Journal	2	6%
IEEE Transactions on Engineering Management (IEEE TEM)	Journal	2	6%
World Academy of Science, Engineering and Technology (WASET)	Journal	1	3%
Twente Student Conference on IT (TSConIT)	Conference	1	3%
The Journal of Strategic Information Systems (JSIS)	Journal	1	3%
The Fourth International Conference on Electronic Business (ICEB2004)	Conference	1	3%
Pacific Asia Conference on Information Systems (PACIS)	Conference	1	3%
Journal of Supply Chain Management (JSCM)	Journal	1	3%
Journal of Enterprise Information Management (JEIM)	Journal	1	3%
Journal of Business Logistics (JBL)	Journal	1	3%
International Journal of Research in IT, Management and Engineering (IJRIME)	Journal	1	3%
International Journal of Business & Management (IJBM)	Journal	1	3%
Interdisciplinary Journal of Contemporary Research in Business (IJCRB)	Journal	1	3%
Information Systems Research (ISR)	Journal	1	3%
Industrial Marketing Management (IMM)	Journal	1	3%
Industrial Management & Data systems (IMDS)	Journal	1	3%
IEEE International Conference on Industrial Engineering and Engineering Management (IEEE IEEM)	Conference	1	3%
European, Mediterranean & Middle Eastern Conference on Information Systems (EMCIS)	Conference	1	3%
European Journal of Operational Research (EJOR)	Journal	1	3%
Decision Support Systems (DSS)	Journal	1	3%
Computers & Industrial Engineering (CAIE)	Journal	1	3%
African Journal of Business Management (ABJM)	Journal	1	3%
Total		**33**	**100%**

4.2.1. IT-Related Attributes

Several IT-related attributes have been mentioned in the literature to assess their impact on Supply chain Performance. IT Integration was the most cited in the literature, it refers to "the extent to which information systems are linked and information is shared among different functions and supply chain parties, thereby effectively creating a virtual supply chain" [17].

Table 10 lists all the IT-related attributes used in selected papers, and papers that have used these attributes.

4.2.2. IT and SCP: What Is the Nature of This Relationship?

The impact of IT on organizational performance has become one of the major preoccupations of both managers and researchers (Li *et al*. 2009), and the positive effects of IT on supply chains' performance have been approved by many researchers [5].

The most important question in the literature is about the nature of this relationship, direct or indirect.

There are very important amount of studies that have evaluated the relationship between IT and Supply Chain Performance, but few studies that tried to assess the direct effect of IT in SCP. Among 33 selected studies, only

Table 10. IT attributes cited in the literature.

IT-related attributes	Papers
IT Integration	P1, P7, P12, P13, P18, P20, P31, P32, P33
IT Flexibility	P13, P17, P27, P33
IT Alignment	P3, P11, P22, P26
IT Infrastructure	P7, P8, P20, P27, P31
IT implementation	P8, P16, P23, P29
IT-enabled sharing capabilities	P2, P5, P10
IT Collaboration	P25, P9
IT Service Quality: - Tangibles - Reliability - Responsiveness - Assurance - Empathy	P21
IT Connectivity	P6, P19
IT Knowledge	P8, P31
IT Assimilation	P27, P31
IT competence: - Technology - Human	P13, P28
IT advancement	P26, P11
IT investments	P10
IT Strategy	P17
E-commerce	P8, P28
Supply chain communication system (SCCS) • Electronic data interchange (EDI) • Electronic mail (E-Mail) Bar coding • Radio frequency identification(RFID)	P15
Green IT	P24
IT Application	P25

3 studies that tried to assess the direct effect of Information Technology on Supply Chain Performance [4] [18] [19]. While others tried to evaluate this relationship indirectly by introducing some factors that have a mediating role.

Two studies that tried to emphasize the direct effect of IT in SCP found there to be no significant relationship, where one study concluded that there is a positive and significant relationship between ERP system and SCP [19].

The other papers that emphasized on the indirect relationship have integrated some mediating factors to assess, on one hand, the relationship between IT-related attributes and these mediating factors firstly, and between the SCP and these mediating factors on the other hand.

All selected papers indicated that there is a positive and significant relationship between IT and Supply chain performance. Only 7 (21, 21%) papers indicated that there is a direct relationship, while 28 papers (78, 79 %) indicated an indirect relationship (shown in **Figure 4**).

4.2.3. Mediating Factors

All 28 papers that tried to assess this relationship indirectly have integrated mediator factors. They all confirmed that these key factors are capable to transform IT-related capabilities into higher value for a Supply Chain Performance.

Table 11 shows list all the mediator factors used in the literature, as shown in the table, supply chain integration is the factor most cited in the selected papers, that refers to "the extent to which a firm strategically colla-
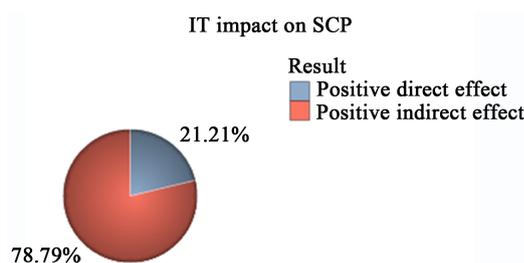

Figure 4. Results of selected papers.

Table 11. Mediating Factors cited in the literature.

Mediating factors	Papers
Supply Chain Agility	P2, P13, P27, P30, P33, P17
Supply Chain Flexibility	P1, P5, P13
Supply Chain Collaboration	P6, P9, P10, P20, P31
Supply Chain Responsiveness	P11, P15, P26
Supply Chain Integration	P8, P11, P13, P15, P18, P19, P29, P31, P20
Information Sharing	P31, P26, P11, P15
Supply Chain Operational Performance	P3, P7
Supply chain robustness	P4
SC Coordination	P11, P15, P26
Supply Chain Visibility	P14, P18
Supply Chain Strategy	P17
Supply Chain Sustainability	P24
Supply Chain Transparency	P18
Supply Chain Process Performance	P12
Supply Chain competitiveness	P13
Supply chain connectivity	P10
Supply Chain Management effectiveness	P21

borates with its supply chain partners and collaboratively manage intra and inter-organization process" [2], followed by Supply chain agility, cited in more than 6 papers, measured by the ability to intense and respond to market changes [20].

4.2.4. Critical Success Factors

Several papers have tried to identify some critical success factors as a major skills and resources required to successful application of IT in supply chain performance context.

While information sharing culture and inter-organization collaboration, "that refers to the extent to which firms intend to exchange crucial and proprietary information with their supply chain partners" [1], are cited as critical factors that allow firms to derive advantages from IT application and integration with , top management support and IT Knowledge has also a critical role.

5. Discussion

5.1. Methodological Quality and Limitations

Each of 33 papers was assessed according to the 6 quality criteria as defined above, **Table 12** shows the results of the quality appraisal. As shown in **Table 5**, the majority of papers got a higher score, 23 papers got 6 which represent more than 70%, the higher score was 6, the lowest was 3 and the median was 5.4.

A number of limitations of the current review can be noted. The key limitation is linked to the paper selection process, and the research was limited to five search engines, which means that some useful papers could have been excluded. However, due to the choice of research request, keywords, and period of publication, come useful articles were excluded.

In the phase of the data extraction, several papers lacked sufficient details about the methodology, data analysis, findings and future research work. This represents a risk that extraction process might have performed in some inaccuracy in the data.

5.2. Further Investigation

At the end of this systematic review, several promising research directions have been illuminated, and can be further investigated in the future research projects.

Taking into account that the majority of papers have been performed using a Survey or case study Methodologies, which don't seek to be representative and may limit the generalization of the findings. Future research is needed to determine whether the findings reported are valid in other areas of firms, in other industries, using a time-series data with multiple informants from each organization [4] [18]-[23].

All papers adopted a perceptual approach to measure the SCM performance that focused just in financial performance. Further work can attempt to blend in objective data in an effort to validate the findings. Using key performance indicators (KPIs) approach may also be a good benchmark and choice in measure SCM performance for future research [7] [21].

Other types of IT-related attributes could influence supply chain performance that deserve further research attention, for example: IT utilization, internal IT integration, and management commitment to IT for supply chain management [21].

The findings affirmed that some IT attributes have a more direct and significant impact on performance for some kinds of supply chain than others, a model for matching IT characteristics with supply chain characteristics is needed to help managers to easily find the best form of IT implementation [4].

There is a need for developing performance measures and metrics for measuring the performance and suitability of IT in Supply Chain Management [16].

Future research could examine the interdependence between some aspects and information technology and the effect of their interactions on the firm's supply chain, for example, human capital, and environmental variables [6] [24].

Table 12. Quality appraisal of research papers.

Quality score	0	1	2	3	4	5	6	Total
Number of papers	0	0	0	2	3	5	23	33

6. Conclusions

The IT has proven to have a direct and indirect impact on the supply chain performance, but there are many questions that must be handled to investigate the relationship between these two complex components, and meet the needs of both managers and researchers.

This review provides the first systematic review of papers published between 2000 and 2014 in the impact of IT on supply chain performance. The initial research retrieved 320 papers, of which 33 were selected to be reviewed in this work that fell into three thematic groups: Critical success factories, IT-related attributes, and mediator factors between IT and supply chain performance.

The main implication of this research for managers and practitioners is that there is a need for firms to invest in IT resources to improve supply chain performance but before, they need to invest in developing some critical success factors and developing some supply chain characteristics that allow them to derive performance advantage from IT capabilities.

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