Internet of Things in Enhancing Competitive Capabilities: An Exploratory Study

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Abstract: As a result of intensifying competition between transportation companies and an attempt to reduce costs, deliver on time, maintain products quality and maintain high flexibility in transportation, it has become imperative for transportation companies to go toward using modern technology, including the Internet of things that may ensure achieving competitive capabilities of companies and continue to remain in the market. The study aims to determine the role of the Internet of things in achieving the competitive capabilities (cost, quality, time, flexibility) and priorities of transportation companies and highlighting the importance of the Internet of things because the transport activity is considered as one of the important logistical activities that have a large share in the cost of products. The theoretical part has been written based on previous literature review, whereas, the practical part has been conducted by using a checklist which is distributed to 31 commodity land transportation companies operating at Ibrahim Al-Khalil International Crossing in Iraq by using the Likert triple scale and arranging the scores on the scale; (Agree, somewhat agree, disagree) with weights (2, 1, and 0) respectively. The most important conclusion reached by the current study is that the Internet of things has a significant role in achieving the competitive capabilities of transportation companies which is proved by the result of the total agreement rate up to 71%. The research presented a set of recommendations which are: The necessity of conducting more research on this topic to enrich the current study and benefit from the current study idea to improve transportation companies' performance in general.

Keywords: Internet of Things, Priorities, Capabilities, Transportation Companies.

1. Introduction

The transportation activity plays a decisive role in the development process by supplying goods, transporting passengers, logistical services, linking the supply chain parties; and providing the right product, at the right time, in the right place, and in the right conditions, with the right cost to the right customers (Ramazan Ertugut, 2011). Brian (2010) sees that transportation activity contributes to reducing carbon emissions and promoting a cooperative and sustainable civil society (Murad et al., 2018). As well as, it has a main role in linking different activities and businesses, so there is a need to manage this activity properly and effectively (Yung-yu Tseng, 2004).

The importance of planning and effective use for transport activity has increased at the present time to confront contemporary transportation problems such as security, reliability, comfort and increasing costs, and these problems have a direct role in the lack of development of this sector (Manoj Kumar & Dash, 2017). Also, the lack of transparency in the transport sector led to a decrease in its efficiency, so the costs increased, and due to certain policies of some countries, many transportations and logistical companies were forced to follow regulations that emphasize reducing costs, so the profitability of these companies became threatened (Zebra Technologies, 2015).

To keep pace with technological development and to face problems, many transportation companies have sought to adopt modern practices in the field of logistics, such as using the Internet of things. With technological development, digital information and sensors have become an inseparable part of the transportation sector, which contributes to managing,

controlling, ticketing, and availability of passenger information (Intel, 2014). Using the Internet of Things (IoT) by many transportation companies requires the necessary infrastructure for information exchange and communication to achieve specific goals in transport activity (Li et al., 2015). Internet of Things (IoT) has helped transportation companies to accelerate their production and profitability processes by using specially designed solutions, enabling companies to capture and share important data, which helped them to achieve high transparency in their operations in real-time and enabled them to make improvements they need (Zebra Technologies, 2015).

Based on the above, the current study attempts to identify the role of the Internet of things in achieving competitive capabilities represented by (low cost, quality, time, flexibility) as indicated by (Krajewski, 2016) for some transportation companies operating at Ibrahim Al-Khalil International Crossing in Iraq by identifying the answer to the main study question which states: Does the Internet of things contribute to achieving the competitive capabilities of transportation companies?

1.1. Problem Statement

After extensive study of previous literature regarding the internet of things and knowing its role in the logistics sector, the researchers made field visits to the Ibrahim Al-Khalil border crossing to see the reality of transportation companies working in it. The researcher noted the positive role played by the Internet of things in the logistics sector. Based on the above, the researchers wanted to find answer to the study's question, which states: Does the Internet of things contribute to achieving the competitive capabilities in transportation companies?

1.2. Significance of the Study

The current study derives its importance by trying to focus on knowing the Internet of things' role in achieving the competitive capabilities in transportation companies and alert transportation companies to take IoT advantages in the practical field to achieve excellence and competitiveness.

1.3. Research Objectives

In light of the study problem and importance, the following objectives are sought:

1. Knowing the concept of the Internet of things and what are the competitive capabilities of transportation companies.
2. Trying to find out whether there is a role for the Internet of things in transportation companies by achieving competitive capabilities.

1.4. Research Hypotheses

H1: The Internet of things has a role in achieving the competitive capabilities of transportation companies.

H2: The role of the Internet of things in achieving the competitive capabilities of transportation companies varies from one dimension to another.

2. Literature review

2.1. Internet of Things (IoT) Concept

The Internet of things is a new entry point for the use of advanced technology in the future lifestyle (Kumar et al., 2019). The Internet of Things (IoT) contributes to linking things (machines, devices, people, etc.) with each other with information exchange (Tadejko, 2015). The Internet of Things helps integration between information and communication technologies associated with a specific application with a number of sensing tools that help in collecting data and transfer it to the cloud, and this allows users to understand the various processes and their effects, thus contributing to making appropriate decisions (Atzori & Morabito, 2010).

The Internet of Things can be described as an Internet-connected to things through using identification technology based on RFID (the technique of identification using radio waves), infrared and GPS waves, intelligent perception, recognition technology, and pervasive computing which extends mainly to the field of business and innovation. IoT can achieve intelligent commodity identification, location, tracking, monitoring, and managing it (Sheng-nan et al., 2015).

The Internet of things is defined as a network of physical objects that deals with devices of various kinds and sizes, including vehicles, smartphones, games, home applications, cameras, medical tools, industrial systems, machines, buildings and people, all of these objects are connected to each other and it shares information based on stipulated

protocols to achieve smart organizations, positioning, tracking, protection, monitoring and control of operations, and as a result, the Internet of things is the Internet that links three components together: people to people; people to machines or things; and the machines or things with machines or things (Patel and Sunil, 2016).

2.2. Using Internet of Things in Transportation Companies

Internet of Things technology can be used in transportation and it is very useful in the field of logistics services, as each object is independently identified, and its data, location and status can be easily accessed through special programs and applications (Tadejko, 2015). Companies seek to benefit from the Internet of things in transport and logistics by linking the logistics processes to each other in a coordinated way because the implementation of IoT technology requires strong cooperation and a high level of participation between the various parties within supply chain (Macaulay et al. 2016). Internet of things is beneficial in the long run for logistics service operators and their customers, whether they are companies or end-consumers. The IoT benefits extend across the entire logistical value chain, including transportation, storage and delivery of products, as well as, it helps monitor the condition of vehicles, parcels and people in real-time throughout the value chain and measure the performance of vehicles, eliminating some manual works, improve quality and predictability, and reduce costs by automating operations. Moreover, IoT can improve how people, systems, and vehicles work together and coordinate their activities. Finally, by using IoT technology it is possible to analyse the entire value chain to identify better opportunities for improvement and best practices (Macaulay et al. 2016).

Through the Internet of Things technology, monitoring the company's assets inside vehicles and cargo ships has become an easy task after it was complicated in the past, and it also allows communication with customers more accurately and allows tracking and better planning of the path, also, Internet of Things technology supports real-time visibility of vehicles location, which reduces waiting times and reduces lost time in stores, improved vehicle utilization, and cost savings that improve customer satisfaction (Cunnane, 2019). In addition, the Internet of things helps to increase security and safety of vehicles by facilitating the monitoring and tracking of vehicles, thus protecting them from theft (Ahmed et al., 2015).

On the other hand, through the Internet of things, traffic congestion will be managed and improved in the future as vehicles will be able to communicate with each other without any human interaction to control traffic, and thus the transportation process can be made smoother and safer by imposing speed limits that must be followed. It is estimated that by implementing smart transportation systems, traffic costs and accidents will be reduced by 15% (Sherly & Somasundareswari, 2015).

Based on the set of previous studies, the authors classify the benefits of using the Internet of Things for transportation into direct and indirect benefits (Murad et al., 2018; Macaulay et al. 2016; Zebra Technologies, 2015; Sherly & Somasundareswari, 2015; Intel, 2016; Cunnane, 2019; Alrifai et al., 2018), as clarified below:

1. Direct benefits: Most of the direct benefits are limited to monitoring, tracking, and occupational health and safety for drivers, vehicles, and goods. Monitoring means monitoring the driver's driving behaviour, the temperature of vehicles and containers of cargo, vehicle's fuel level, the load capacity as well as the unauthorized trucks used by drivers. As for tracking, it includes real-time vehicle tracking, re-routing trucks to choose the shortest and least crowded roads, scheduling vehicle maintenance and thus reducing costs, following up on people and parcels, avoiding theft of vehicles and goods, and easy communication between the driver and maintenance technicians at anytime and anywhere. The Internet of things also enhances occupational health and safety by preventing collisions, alerting drivers in situations of inattention or fatigue by following pupil of driver eyes and the frequency of blinking, and thus the alarm system works to activate audio alerts and seat vibrations when the driver loss attention.
2. Indirect benefits: There is also a set of indirect benefits that are achieved by using Internet of things technology in the transportation sector, such as facilitating the use of transportation means, managing schedule effectively, increasing vehicles efficiency, reducing operating hours, avoiding traffic congestion, reducing fuel consumption, reducing wait times, faster delivery, improving transportation quality, reducing costs, consequently, enhancing customer satisfaction.

2.3. Competitive Priorities and Capabilities

Several authors have written about competitive priorities and capabilities. The idea of competitive priorities goes back to (Chanberlin, 1939) who linked priorities to capabilities. Porter (1985) presented his well-known model of competitive priorities which have been considered as strategic goals (Dherib, 2020). The concept of competitive capabilities refers to companies having capabilities that are not available to their competitors (Potjanajaruwit, 2018), or using certain capabilities that competitors cannot imitate (Alghamdi, 2016). Hensmans (2001) believes that innovation-seeking firms realize the importance of competitive capabilities (Kang & Na, 2020), and it is very important for enhancing companies' position in the market (Cetinkaya et al., 2019).

The dimensions of the competitive advantage are cost, quality, time, and flexibility that a process or supply chain actually possesses and is able to deliver, whereas, the competitive priorities mean the critical operational dimensions that a process or supply chain must possess to satisfy internal or external customers both now and in the future. (Krajewski, 2016). Table 1 below clarify the competitive priorities and capabilities.

Table 1: Definitions of Competitive Priorities

Capabilities	Priorities	Definition
Cost	Low-cost operations	Introduce products at the lowest possible cost to satisfy customers along the supply chain
Quality	Top quality	Providing a distinct service or product.
	Consistent quality	Producing services or products that meet design specifications on a consistent basis.
Time	Delivery speed	Fill out or quickly issue a customer's request.
	On-time delivery	Meeting delivery-time promises
	Development speed	Quickly introducing a new service or a product
Flexibility	Customization	Satisfying the unique needs of each customer by changing service or product designs
	Variety	Handling with a wide range of services or products efficiently
	Volume flexibility	Accelerating or decelerating the production rate of products to deal with large fluctuations in demand

3. Methodology

In organizing and writing the theoretical part of the study, the researchers have relied on previous studies and books related to the current study. As for the practical side, the researchers have made field visits to record the necessary observations regarding the research and the checklist has been used as the main method for data collection, which was established precisely based on the theoretical framework of the current study. The checklist was revised by three specialists with a professor's degree in the field of logistics, transportation and marketing, and after ensuring the checklist reliability, it has been distributed to 31 transportation companies operating in the field of transportation at Ibrahim Al-Khalil International Crossing in Iraq.

Several statistical methods have been used to analyse collected data as follows:

1. Calculating the approximate rate of agreement with the cut-off threshold of (66.6) through the following equation:
2. Weighted arithmetic mean = sum of (weights x frequencies average) / sum of frequencies average.
3. Calculating the percentage of conformity with the cutoff threshold of (66.6) through the following equation:
Percentage of agreement = weighted arithmetic mean / 2
4. Calculate the gap size through the following equation: The gap size = 1 - the percentage of agreement

The triple Likert scale has been used in the checklist according to agreement degree (agree, somewhat agree, disagree) with weights (2, 1, 0) respectively. The scale direction has been calculated through hypothetical mean (1.5), which is adopted by studies, especially in the humanities (Al-Zaidi et al., 2016).

Table 2: Checklist to determine the role of the Internet of things in achieving competitive capabilities in the researched companies

		Items of IoT and Competitive Capabilities	Agreement Ratio					
			Agree (2)		Agree to some extent (1)		Disagree (0)	
			F.	%	F.	%	F.	%
Cost	1	The Internet of Things makes transportation more efficient.	28	90.3	1	3.2	2	6.4
	2	The Internet of Things contributes in reducing transportation costs.	20	64.5	4	12.9	7	22.5
	3	The Internet of Things enhancing customer satisfaction by reducing product costs	18	58	7	22.5	6	19.3
Quality	4	The Internet of Things enables the transportation process to provide the desired product perfectly	13	41.9	12	38.7	6	19.3
	5	The Internet of things helps the transportation process by providing products that meet design specifications	11	45.4	16	51.6	4	12.9
	6	Internet of things helps the transportation process to reduce errors.	18	58	8	25.8	5	16.1
Time	7	The Internet of Things contributes to the fast delivery of transport orders	23	74.1	4	12.9	4	12.9
	8	The Internet of Things helps the transport process to deliver the product on time	15	48.3	10	32.2	6	19.3
	9	The Internet of Things enables the transport process to introduce a new service or product quickly	16	51.6	9	29	6	19.3
Flexibility	10	The Internet of Things helps re-planning the transportation process to meet various types of customer needs.	24	77.4	7	22.5	0	0
	11	Through the Internet of Things, the transport process can efficiently deal with a wide range of services or products.	26	83.8	2	6.4	3	9.7
	12	Internet of things enables the transportation process to accelerate or slow down the production and deal with fluctuations in demand quickly	16	51.6	12	38.7	3	9.6
Statistical Percentages	Frequencies average		17	54.8	10	32.2	4	12.9
	Frequencies average * weights		17 * 2		10 * 1		4 * 0	
	weighted mean arithmetic		1.42					
	Percentage of agreement%		71					
	Gap Size %		29					

Source: Authors

4. Data Analyze and Results

This part shows the results of the statistical analysis that the researchers reached through a number of well-known and accepted statistical tests used with the checklist to determine the extent of conformity and the gap size with the cut-off threshold of (66.6%), i.e. identifying the role of the Internet of things in achieving the competitive capabilities adopted in this study.

4.1. Calculating Total Agreement Rate:

Table (2) refers to the approved checklist and shows the frequencies (F.), weighted arithmetic average, agreement ratios and gap size to identify the extent of the total agreement of responses in the researched companies and to test the study hypothesis as follows:

The results in table 2. shows that the respondents’ answers about the extent of agreement in the companies surveyed at the total level compared to the cut-off threshold of 66.6 are high and above the acceptable level of agreement, with the total conformity rate reaching to 71% and gap size 92%. The weighted mean arithmetic result, which amounted to 1.42, which is an acceptable percentage compared to the hypothetical average adopted in this study which is estimated at 2. As shown in the table, the agreement percentage has been increased by the first variable which indicates that the Internet of things contributes to making the transport processes are more efficient, and the eleventh variable which refers to that the Internet of things contributes to improving flexibility of transportation and make it able to deal with a wide range of products efficiently. Based on the previous results, it becomes clear that the first main hypothesis of the study has been realized, which states: The Internet of things has a role in achieving the competitive capabilities of transportation companies.

4.2. Calculating Partial Agreement Rate of Capabilities Dimensions:

This part try to verify the second hypothesis of the study and to identify which dimension of capabilities was more responsiveness to the effect of the Internet of things and obtained the highest agreement percentage as clarified in table 3.

Table 3: The role of the Internet of Things in achieving competitive capabilities separately

	The related question to IoT and competitive capabilities											
	Cost			Quality			Time			Flexibility		
	2	1	0	2	1	0	2	1	0	2	1	0
Frequencies average	22	4	5	14	12	5	18	8	5	22	7	2
Frequencies average * Weights	22*2	4*1	5*0	14*2	12*1	5*0	18*2	8*1	5*0	22*2	7*1	2*0
weighted mean arithmetic	1.55			1.29			1.42			1.65		
Percentage of agreement%	77.5			64.5			71			82.5		
Gap size %	22.5			35.5			29			17.5		

Source: Authors

The results of Table (3) show that there is a variance in the responses of the respondents at the level of each dimension. The flexibility dimension has got the highest agreement rate which means that the Internet of things has the main contribution in achieving the required flexibility in the transportation process in terms of planning and speeding up or slowing down the transportation process, as well as, dealing with many products. The results also show that the Internet of things plays a significant role in reducing transportation costs and enhance the required efficiency, which is important for company managers. The time dimension has come after flexibility and cost dimensions in the order of importance,

and this indicates that the Internet of things helps the transportation process to accelerate orders delivered within the specified time.

The results also showed that the percentage of agreement for the respondents' answers about the quality dimension is 64.5, which is less than the cut-off threshold value of 66.6, so we conclude that the Internet of things has the lowest role in achieving the quality dimension of competitive capabilities in the transportation process in the current study. The role of the Internet of things in quality capability has focused on providing the desired product perfectly and reducing errors in the transportation process. Based on the previous results, the second main hypothesis of the study has been proved, which states: The role of the Internet of things in achieving the competitive capabilities of transportation companies varies from one dimension to another. As the results showed that there is a discrepancy in agreement between the dimensions (flexibility, cost and time), while the quality dimension got the lowest percentage.

5. Conclusion

The concept of the Internet of Things is a modern topic produced by technological development, which attracted many vital sectors, including logistics and transportation, to benefit from its advantages and enhancing competitive capabilities. The results showed that the Internet of things has a significant role in achieving competitive capabilities of transportation companies under study which varied depending on the degree of agreement, so the IoT have more influence on flexibility than cost and time whereas, the quality capability was affected slightly. In the current study, the results have shown that the Internet of Things has a role on some competitive capabilities which is (flexibility, cost, time), whereas, the quality has been slightly affected by the internet of things although, IoT has enhanced two of quality dimensions which are (provide the desired product perfectly and reducing errors in transportation process).

Finally, the researchers proposed some recommendations to transportation companies. Firstly, the transportation companies under study are recommended to pay attention towards using Internet of Things in transportation activities to improve their competitive capabilities. Secondly, trying to find out the true dimensions that represent the dimensions of quality in the field of transportation, and how the Internet of Things can achieve these dimensions. Thirdly, the researchers are recommended to study the current dimensions in the other countries with applying them again in transportations companies, also, take another field of transportations means such as trains, ships and airplanes to know the extent of matching the results.

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