THE IMPACT OF CLOUD MANUFACTURING ON IMPROVING SERVICE QUALITY / ANALYTICAL DESCRIPTIVE RESEARCH FOR THE OPINIONS OF A GROUP OF EMPLOYEES IN ASIA CELL COMPANY.

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ABSTRACT: Purpose: *This research aims to investigate the impact of Cloud Manufacturing on improving Service Quality. Cloud Manufacturing is one of the most prominent modern concepts in Industry 4.0, which is expected to have a significant impact on Quality.*

Theoretical Framework: *In the era of Industry 4.0, new opportunities arise for organizations to maintain a consistently high level of quality and meet the dynamic change in the needs of their customers, and new ideal levels of performance can be reached by Cloud Manufacturing. Therefore, the research provides a framework of knowledge for some of the intellectual and conceptual foundations of the research variables, represented by (Cloud manufacturing, Service Quality).*

Design/Methodology/Approach: *The analytical descriptive approach is mainly used in presenting, analyzing and interpreting the research data. which include the field method, a questionnaire form for data collection and analysis. as the research is applied to a sample of workers, including administrators and technicians, consisting of (74) individuals. The research population is represented by the Asia Cell Company in Iraq, as the Karbala branch is chosen as a sample for research.*

Findings: *The research is depended on a set of statistical tools (Percentages, Arithmetic Means, Standard Deviations, Relative Importance, Correlation Coefficient, and Regression), in analyzing data and testing hypotheses through the use of programs (SPSS v.28, Smart-Plas3, Microsoft Excel 2016), with to describe diagnose variables and measure the relationship Correlation and Impact between them.*

Research, Practical & Social implications: *While companies search to improve the work system and achieve the best performance, which is the important part in the aspects of distinguished management, through improving quality and eliminating losses and damage. And innovating new methods and procedures for quality to reach perfect control in manufacturing. Cloud manufacturing provides the right environment for quality improvement.*

Originality/value: *This research came as the first study in Iraq in general and in Asia Cell Company in particular, which search from a managerial perspective, and studies the advantages of Cloud Manufacturing and its impact on improving the Service Quality.*

Keywords: Cloud Manufacturing, Service Quality.

INTRODUCTION:

Organizations research to achieve success and excellence to maintain their customers, gain new customers, and expand their work circle by improving the quality of their services. As many of these organizations are facing difficulties in improving their services and retaining their customers, and with the progress witnessed by the industry today from rapid changes to move towards Industry 4.0 and the subsequent successive technological developments and innovations in operations, these organizations were forced to find new ways to accomplish their work and absorb the leaders of these developments and understanding the environment around them to ensure their ability to keep pace with the new technological revolution and to find new opportunities for continuity and competition.

With the advent of Cloud Manufacturing (CM), modern manufacturing is shifting from production-oriented to service-oriented manufacturing as a promising new manufacturing model that is emerging (Ren et al., 2015). Manufacturing technologies are integrated with Internet-based Industry 4.0 technologies and associated models, which is considered one of the most important tools to support the competitive advantage of the organization (Hu et al., 2008), because of what it achieves adding new features to services that are not provided by traditional technology, the most important of which is Service Quality (SQ), increasing production flexibility, timely delivery, and reducing costs that do not add value to the service and the organization.
From this logic, the current research seeks to study the relationship between (CM) in its dimensions (Security, Performance, Regulation, Cost) and (SQ) in its dimensions (Data, Analytics, Applications, Communication).
The research contributes to presenting the research variables from an administrative perspective, as little of the literature had dealt with Cloud manufacturing from an administrative perspective, as most of it focused on an engineering and technical perspective. Despite the years of research and development of Cloud manufacturing, its advantages had not been fully proven (Wang, 2021). In addition to his contribution to the correlation of research variables with several areas (quality, manufacturing processes, information, and communication technology).
The general research problem stems from not delving into the extent of the impact of (CM) on (SQ) and studying it in the light of Industry 4.0 at the Arab and Iraqi levels, as it requires a cognitive and scientific diagnosis based on scientific concepts private through research variables and the nature of the relationship that links them, and the extent of its depth at the field level and its realistic representation In Asia Cell Company, the research problem can be formulated with the following questions:
1- What is the degree of availability of (CM) foundations in Asia cell?
2- What is the level of interest in the necessary foundations to improve (SQ) provided by Asia Cell?
3- The extent to which Asia Cell has adopted (CM) in the services provided?
The importance of this research is evident from the great importance of the research variables (CM) and (SQ), as (CM) mainly focuses on (providing safe, reliable, high-quality, low-cost, on-demand manufacturing services) (Zhou et al., 2013:1). (CM) has included the integration of many Industry 4.0 technologies such as cloud computing, Internet of things, virtual reality, and big data analysis that can have a positive impact on (SQ).
The research aims to identify the basic foundations of (CM) and their availability in the researched company and to identify the company's level of interest in the basic foundations of (SQ) provided. Through the following points:
1- Presentation of some literature and the intellectual and conceptual foundations of the research variables.
2- Defining the relationship between the foundations of (CM) and the foundations of (SQ) in the researched company.
3- Testing and measuring the correlation and impact between (CM) and (SQ) in the researched company.

LITERATURE REVIEW:

First: Cloud Manufacturing (CM):

1. The Concept of Cloud Manufacturing (CM):

The manufacturing industry and operational may not survive in Industry 4.0, without the support of computer-aided manufacturing resources and capabilities, information technology, and communication networks. The technologies of this industry (Cloud Computing, Internet of Things, Cyber and Physical systems, virtualization, ...). There is a need to manage the organizational philosophy of sustaining technological progress and globalization through the application of information technology and Industry 4.0 technologies (Baqleh and Alateeq, 2023:3). can also improve manufacturing processes through product design, resource planning, management of manufacturing resources and capabilities, achieving integration of distributed manufacturing resources and capabilities, and create a flexible infrastructure and sharing across geographically dispersed manufacturing and service locations, which in turn leads to a cloud-based manufacturing model as the next generation manufacturing model.

The first appearance of the concept of (CM) was by (Li et al., 2010:3) had defined it as a new model of network-based manufacturing and service platform that combines network manufacturing, cloud computing, and other technologies such as the Internet of Things, cloud security and high-performance computing, and organizes manufacturing resources via the Internet (Cloud) to provide users with various on-demand manufacturing services according to their needs. Li had focused on unified and centralized intelligent management and operation to provide and obtain manufacturing services anytime, anywhere, that are of high quality, safe, reliable, and low cost, covering the entire manufacturing lifecycle.

Whereas (Wu et al., 2013) had defined as a model that achieves and develops rapid product development at a low cost and enhances knowledge and sharing of design and manufacturing resources through a social network and negotiation platform between service providers and users. A cloud is a type of shared and distributed system consisting of a set of interconnected physical and virtual services. Wu had focused the core features of self-service demand, ubiquitous network access, rapid scalability, resource pooling, and virtualization.

(Yadekar et al., 2014) had defined it as a new manufacturing model that resulted from the change in global markets and their requirements, it was developed from advanced intelligent automated techniques for manufacturing, modern information technology, and developments in advanced communication networks, as this model provides faster, safer, and higher services Quality, cost-effective and on-demand over the entire manufacturing lifecycle. Yadekar focused on the ability to encapsulate manufacturing resources and capabilities needed for the entire lifecycle of a product, on the cloud and transforming these resources and capabilities into service under the support of cloud computing (Yadekar et al., 2014).

From the researcher's point of view, the concept of (CM) can be given as an extension of Computer-based Manufacturing (CAx: Computer-Aided Design, Manufacturing, Planning, and Scheduling) and advanced technologies of information technology and modern communication networks, and it is an extension of (Computer-Integrated Manufacturing, Agile Manufacturing, Virtual Manufacturing, Manufacturing Global, Manufacturing Network), transform manufacturing resources and capabilities into a cloud-powered service that can be shared and accessed anytime, anywhere, with high quality, secure, reliable, and low cost that covers the entire manufacturing lifecycle.

2. (CM) System Architecture:

Many researchers have proposed structures for the development of cloud manufacturing platforms, most of which focused on two types: the first type relates to the deployment of manufacturing software on the cloud, and the second type has a broader scope, including manufacturing capabilities (design, production, experimentation, management, and communication) and manufacturing resources (software, hardware) (Hardware: Manufacturing equipment, control devices, computer resources, materials, storage, transportation) and (Software: programming, knowledge, skill, personnel, experience, business network).

(Li et al., 2010) proposed a 5-layer CMfg system architecture: (1. The physical manufacturing resource layer: manufacturing hardware, equipment, and tools, 2. The virtual manufacturing resource layer: networked manufacturing resources, manufacturing service identification tools, virtualization tools, etc. That was 3. Basic Service Layer: A layer dedicated to cloud users from a provider, user, and operator of the cloud, 4. Application Interface Layer: Dedicated to specific manufacturing applications and general management oriented, 5. Cloud manufacturing application layer: A layer directed to various domains in the manufacturing industry to access the cloud).

Whereas (Xu, 2012) proposed a 4-layer CMS architecture (1. Manufacturing resource layer: the manufacturing resources needed to develop the product lifecycle, including physical manufacturing resources and manufacturing capabilities, 2. Virtual manufacturing layer: the main functions of this layer are to identify and make manufacturing resources Virtualization and aggregation as manufacturing cloud services, 3. Global Service Layer: A set of technologies for cloud deployment, such as the Internet of Things, and an effective central management system to provide manufacturing operations with dynamic cloud services. 4. Application layer: This layer acts as an interface between the user and cloud manufacturing resources).

Whereas (Wang et al., 2015) proposed a 3-layer ICMS architecture (1. Cloud layer: acts as a supervisor and coordinator on the entire production system, 2. Physical resource layer: production tasks are taken from the controllers and translated into practical steps and then Control of signals that drive physical devices, 3. Local servers: They filter and process local data and then upload it to the cloud, and also serve as a user interface for the cloud).

3. (CM) Dimensions:

some studies had indicated the main dimensions of (CM) (Security, Performance, Regulation, Cost) (Xu, 2012) (Ogunde & Mehnen, 2013) (Yadekar et al., 2016:15), and as explained below:

a. Security: Among the main issues that organizations care about greatly is the security and privacy of data in the (CM) environment, which had focused on data security from physical security to virtual security (Wu et al., 2013) because manufacturing resources and capabilities need many advanced technologies and networks to encapsulate in the cloud (Wang, 2021), these technologies result in an environment prone to security breaches and loss of control over data and applications (Yadekar et al., 2014). Cloud services technology must provide a series of security policies for service users (Ren et al., 2015).

Among the most important aspects related to Security (breach or leakage or hacking, control, location, secure cloud service interfaces, application security, security and development of cloud service interfaces, dispatch, remote access, and encryption levels).

b. Performance: Performance is one of the basic requirements in the use of service-centric cloud services technology, its availability, and its ability to dynamically adapt to changes, which improves the operational efficiency of the system (Xu, 2012). (CM) systems require the integration of many advanced technologies and networks with the basic manufacturing system and manufacturing activities (Yadekar et al., 2016), and coordination between (providers, operators, users) of cloud services to transform physical manufacturing resources and capabilities into virtual resources (Ren et al., 2015). In doing so, it facilitates the management and sharing of the vast and growing amount of data in real-time during manufacturing activities (Adamson, 2017).

Among the most important aspects related to Performance (scalability, bandwidth capacity, service availability and fault tolerance, hardware availability, system integration, interoperability, protection of physical resources for manufacturing, delivery, and Vendor lock of cloud service).

c. Regulation: Cloud services technology provides a new and effective approach to managing collaborative, distributed, and connected manufacturing processes across the cloud (Adamson, 2017). The relationship between stakeholders must be more efficient and effective by using agreements and regulations that clarify the responsibilities and duties of each party (Yadekar et al., 2016). Cloud service level agreements are an effective way to ensure the quality of service (Xu, 2012). Therefore, the (CM) system needs to be measured in a standardized and quantifiable manner (Wang et al., 2015). (CM) operates under a unified, centralized intelligent management of all manufacturing activities, and requires relevant standards and specifications to support the implementation process (Li et al., 2010).

Among the most important aspects related to regulation (authentication mechanism, administrative regulation, permission control, user limits, quality control and assurance, training, standards, cost/price change, cloud (SQ)).

d. Cost: From an economic perspective, lower information technology infrastructure costs, efficient resource sharing across geographies, and rapid response to market demands, will increase (CM) productivity and reduce costs (Adamson, 2017). The cloud can provide savings stemming from eliminating some traditional functions and its ability to make changes easily and in less time (Xu, 2012). The cloud also provides advantages in assisting businesses and achieving cost savings by avoiding the cost of over- and under-provisioning of the cloud service, in addition to the lower investment cost in purchasing information technology assets (Ogunde & Mehnen, 2013). However,

switching cloud service providers can be costly and time-consuming, due to the difficulty of extracting data from the cloud (Yadekar et al., 2013).
Among the most important aspects related to cost (investment, quick access, flexibility, move to the cloud, additional services, information system growth, migration from the cloud, request a review, disaster recovery).

Second: Service Quality (SQ)

1. The Concept of Service Quality (SQ):

Industry 4.0 technologies have had an impact on (SQ) service, as they have in all other industries. Advances in information technology and communication networks, improvement in the industrial environment, and quality-related decision-making activities based on the real-time data flow through sensors and the real-time analysis systems for automatic control and inspection during the entire product lifecycle have resulted in improving (SQ) and product and overall organizational performance, in addition to reducing the overhead costs of quality (Sader et al., 2021). Abdullah & Elkhaldi indicate that the use of cloud computing as one of the Industry 4.0 technologies reduces financial burdens and improves service quality (Elkhaldi and Abdullah, 2022). On the other hand, with the increase in development and continuous improvements in the level of services, the awareness of customers about the level of (SQ) provided to them has increased, which has increased pressure on organizations to continuously improve their services, meet the expectations of their customers, retain them and increase their loyalty.
Parasuraman and others saw two important things about (SQ): the first is that customers are the only judge of (SQ) by comparing their expectations of the service they want to receive with their perceptions of the service they have already received, and the second is how easy it is for managers to ignore the first and not be sure of the quality of service to customers (Parasuraman et al., 1990).
Caro & García pointed out that (SQ) is a complex construct and there has been a need to develop a specific concept and measure for different services. Customers make their judgments on the quality of service based on a series of primary factors of the service, and then customers base their evaluation of the primary factors on the evaluation of the corresponding sub-factors, and finally, combining all these perceptions forms the perceived (SQ) of the customer (Caro & García, 2007).
While Polyakova & Mirza had identified an unconventional alternative to (SQ) from a customer perspective, the analysis included a comparison of performance and the importance of each attribute. Performance analysis is a reflection of customers’ perceptions of the direction of service provision, and a technique for identifying service attributes that need to be improved or reduced costs without compromising overall quality, while the analysis of the importance of each attribute is considered a representation of the relative value that the customer assigns to the service provided (Polyakova & Mirza, 2015).
While Sony believed quality is the digitization of design quality, conformance quality, and quality of performance and integration of them with modern technologies of Industry 4.0, as it improves the organization's ability to continuously provide high-quality products and services. Sony had focused on core concepts (intelligent manufacturing, cyber and physical systems, self-regulation, distribution systems purchasing and developing products and services, adapting with human), and will drive improvements across the value chain (Sony et al., 2020).
From the researcher’s point of view, the concept of (SQ) in Industry 4.0 cannot be defined within a specific measure or concept, as it reflects the expectations of diverse customers and exceeds their perceptions, and its quality is related to modern technologies and the impact of these technologies on design quality, conformity quality, performance quality, communication quality, and the extent of customer participation in providing the service and providing their opinions.

2. Importance of (SQ):

The concept of quality has expanded from being aimed at minimizing defective products and controlling processes to a more comprehensive concept with intensive monitoring of all the elements that contribute to the production value chain (Heizer, 2020) (Suhardi & Marindra, 2020). three reasons why quality is important:

a. Company Reputation: The company can expect its reputation from the quality of the products or services it provides to its customers and from the customer's perceptions of the company's new products, its hiring practices, and its relationships with suppliers (Heizer, 2020). Manawadu also indicated that quality will increase the company's reputation, increase its attractiveness to customers, and reduce the cost of maintenance (Manawadu et al., 2013).

b. Product liability: Products and services are subject to special for their standards, and legislation imposes laws governing the safety of these products and services on the companies that manufacture or provide them, and these companies are liable for any damages or injuries caused by their use (Heizer, 2020). Work machines and other facilities used in the value chain of the production process must be monitored according to needed criteria. and make corrections to ensure that the product meets the planned standards, so that product quality can be achieved. Also, the quality objectives determine the company's position in the market (Manawadu et al., 2013).

c. Global implications: With the current technological development, quality has been an international concern. For a company or country to compete effectively in the global economy, its products and services must meet quality expectations (Heizer, 2020). Industry 4.0 technologies such as cloud computing, Internet of things, cyber and physical systems, and big data analysis are being used to meet quality requirements in terms of design, conformance, and performance, as intelligent connected products and services expand the opportunities for differentiation, improve continuously, and create competitive dimensions that go beyond price alone (Sony et al., 2020).

3. (SQ) of Dimensions:

Modern organizations are undergoing a drastic change in design, engineering, manufacturing practices, and other technologies. With the advent of Industry 4.0, many companies are struggling with quality management. Quality management must closely correspond with Industry 4.0 technologies (Sony et al., 2021). (Dan, 2017) (Jang et al., 2019) (Sony et al., 2021) (Sader et al., 2021) suggested the new quality dimensions in the context of Industry 4.0. (Data, Analytics, Applications, Communication), and as described below:

a. Data: Decision-making based on appropriate data is at the heart of quality improvement (Dan, 2017). The machines, by virtue of their interconnectedness, will generate large, diversified, and fast data that revolves primarily around operating and maintenance conditions (Sony et al., 2020). Therefore, quality regulation based on data has advantages in error analysis and processing methods (Sader et al., 2021). The integration of reliable and accurate data in quality will lead to a multi-directional flow of information from different departments, supply chains, and customers (Sony et al., 2021).

Among the most important aspects related to data (size, diversity, speed, reliability, transparency).

b. Analytics: Data analysis reveals insights hidden in data (Dan, 2017). Big data will enable a comprehensive understanding of customers' needs (Sony et al., 2020), and analyze them to produce high-quality products and services (Sony et al., 2021). Therefore, the use of new data science tools such as artificial intelligence, machine learning, and deep learning, because of their ability to find high-precision relationships and patterns to collect and analyze simple and advanced data that affect the quality (Sader et al., 2021), and predict solutions and proactive responses to them (Jang et al., 2019).

Among the most important aspects related to analytics (description, diagnosis, finding solutions, forecasting, directing).

c. Applications: Applications play an important role in communicating intelligence, engagement, and reliability in terms of the content they provide to the user, and become powerful enablers of collaboration, efficiency, and effectiveness (Dan, 2017). Software applications analyze and control manufacturing process auto-tuning, then real-time integration and synchronization of manufacturing data and other activities to take countermeasures that prevent production system failures (Sader et al., 2021). Orienting activities, planning, monitoring, and quality improvement towards different

stages of the product life cycle requires data integration with the customer and the organization (Sony et al., 2020).
Among the most important aspects related to applications (manufacturing, logistics and sales, after-sales service, purchasing, decision-making).
d. Communication: linking all parts of the production value chain of people, products, and processes with other business management models such as Enterprise resource planning, product life cycle management, and quality management (Sader et al., 2021). Business information technology and operational technology were linked (Dan, 2017). Industry 4.0 integrates cyber and physical systems together using enabling systems, machine-to-machine communication, and the Internet of Things, creating a smart factory that deals with the complexities of modern production (Sony et al., 2020). It leads to the joint improvement of technical and human systems to manage products and services and thus improve productivity (Sony et al., 2021).
Among the most important aspects related to communication (connected workers, connected products, connected end devices, connected processes, effective data communication).

RESEARCH METHODOLOGY AND METHOD:

First: Research Methodology and Research population and sample:

1. Research Methodology: to achieve the objectives of the research and reach the validity of its hypotheses, the researcher used the descriptive analytical method, which included the field method, a questionnaire form for data collection and analysis, which included (56) paragraphs and as shown in the Appendix (1).
2. Research population and sample: The research population is represented by the Asia Cell Company in Iraq, as the Karbala branch was chosen as a sample for research, which consisted of a group of administrative and technical workers. (90) questionnaire forms were distributed, of which (5) were not valid for statistical analysis, (11) were not returned, and (74) were valid for analysis.

Second: the hypothetical research scheme:

The research scheme shown in Figure (1) explains the two relationships of correlation and impact between the main research variables and their sub-dimensions, as follows:

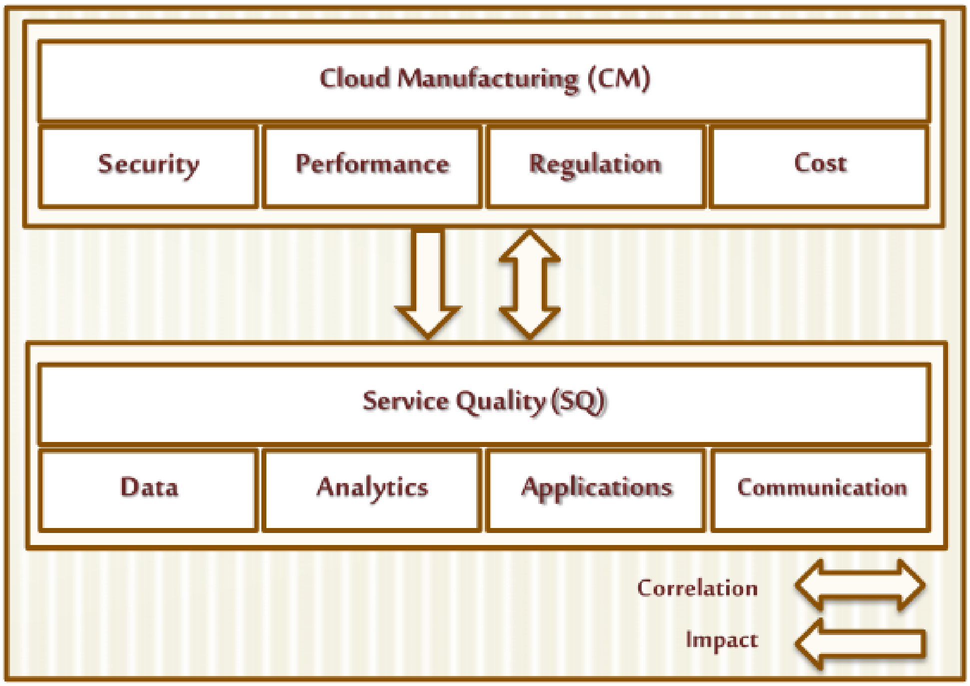

Figure No. (1) Hypothesis Research Scheme

Third: Research hypotheses

The research attempts to prove the validity of the following hypotheses:

First Main Hypothesis: (There is no significant correlation between (CM) with its dimensions and (SQ) in the researched company). It stems from the following sub-hypotheses:

a. There is no significant correlation between the Security dimension and the (SQ) in its dimensions.

b. There is no significant correlation between the Performance dimension and (SQ) in its dimensions.

c. There is no significant correlation between the dimension of Regulation and (SQ) in its dimensions.

d. There is no significant correlation between the Cost dimension and (SQ) in its dimensions.

Second Main Hypothesis: (There is no significant impact of (CM) with its dimensions on (SQ) in the researched company). It stems from the following sub-hypotheses:

a. There is no significant impact between the Security dimension and (SQ) in its dimensions.

b. There is no significant impact between the Performance dimension and (SQ) in its dimensions.

c. There is no significant impact between the dimension of Regulation and (SQ) in its dimensions.

d. There is no significant impact between the Cost dimension and (SQ) in its dimensions.

Results and Discussion

First: search measures:

The questionnaire had been prepared based on a set of global scales adopted in measuring and describing research variables (Cloud Manufacturing (CM), Service Quality (SQ)), which can be clarified in Table (1) below:

Table (1) Measures of research variables

Axis	Seq.	Variables Dimensions		No. items	scale
		Main	Sub		
First Axis	1	demographic and occupational information	Gender	2	Researcher preparation
			Age categories	4	
			work specialty	3	
			Scientific Qualification	6	
			Career Service	4	
			Cloud type	4	
Second axis	1	Cloud Manufacturing	Security	9	(Xu, 2012) (Ogunde & Mehnen, 2013) (Yadekar,2016)
			Performance	9	
			Regulation	9	
			Cost	9	
	2	Service Quality	Data	5	(Dan, 2017) (Jang et al., 2019) (Sony et al., 2021) (Sader et al., 2021)
			Analytics	5	
			Applications	5	
			Communication	5	

Source: Prepared by the researcher based on the referenced literature.

Second: Description of the questionnaires:

(90) questionnaires had been distributed to a group of administrative and technical workers in the Asia Cell / Karbala branch. The recovered questionnaires amounted (79) questionnaires, (5)

questionnaires had been excluded from them because they were not suitable for statistical analysis, so the total number of questionnaires valid for analysis was (74) questionnaires. As shown in Table (2) below:

Table (2): Questionnaires that are valid for statistical analysis

research population	Questionnaire	number	percentage
Asia Cell Company / Kerbala Branch	spreader	90	100%
	recovered	79	88%
	valid	74	82%

Source: Prepared by the researcher based on the results of the questionnaires.

Third: Analysis of the demographic and occupational data of the respondents in the questionnaire:

Table (3) showed that the percentage of males in the company amounted to (, while the percentage of females had registered (16%). Because of the fact that the nature of work in the company is of a male nature, which had depended on it in managing its business, especially the technical ones, it did not neglect the positive role of women. As for the age group, the highest percentage had been for categories (20-30) years as it had reached (50%) and categories (31-40) years at (32%), meaning that the company had relied on its work on young human energy that could enhance the overall performance if it had been used correctly, in addition to the indispensable experience of people with categories (41-50) by (9%) and (51 or more) by (8%). The results also showed that the highest percentage of work specialization had been administrators (64%), while the specialization of information technology/communication networks (36%). And given that the company had depended on the public cloud, as would be explained later, a percentage of (0%) appears for a designer/manufacturer of cloud services.

Table 3: The research sample's occupational description and demographics.

Adjective	categories	Frequency	percentage	Adjective	categories	Frequency	percentage
Gender	Male	62	84%	Scientific Qualification	M.A.	3	4%
	female	12	16%		Higher Diploma	0	0%
Total		74	100%		B.Sc.	57	77%
Adjective	categories	Frequency	percentage		Diploma	8	11%
Age categories	20-30	37	50%		middle school	2	3%
	31-40	24	32%	Total		74	100%
	41-50	7	9%	Adjective	categories	Frequency	percentage
	More 51	6	8%	Career Service	1- 10	55	74%
Total		74	100%		11-20	19	26%
Adjective	categories	Frequency	percentage		21-30	0	0%
work specialty	Management	47	64%		More 31	0	0%
		27	36%	Total		74	100%

	Information technology			**Adjective**	**categories**	**Frequency**	**percentage**
	Cloud manufacturer /designer	0	0%	Cloud type	public cloud	68	92%
Total		74	100%		private cloud	3	4%
Adjective	**categories**	**Frequency**	**percentage**		Shared cloud	2	3%
Scientific Qualification	Ph.D.	4	5%		Hybrid cloud	1	1%
				Total		74	100%

Source: Prepared by the researcher based on the results of the questionnaires

Fourth: Testing the Validity and Reliability of the research measures:
To test and evaluate the quality of research measures. These methods had been used, represented by (Validity and reliability): Validity shows the accuracy of the scale in representing the phenomenon to be studied, as it had shown that the scale measures what it is supposed to measure. As for reliability, it refers to the degree of the scale's ability to display similar results when retesting (Sekrana, 2003). Hair and others had shown that there were three cases in which the saturation of paragraphs could be assessed for the scale, namely: first (if the paragraph saturation is greater or equal to (0.70)), it represents the dimension and therefore is preserved), second (if the paragraph saturation is between (0.50-0.70)) The least paragraph must be deleted to raise the value of the scale of the measurement model represented by (Cronbach's Alpha, Composite Reliability, Average Variance Extracted), if there is no effect on the scale, it would be kept. Third (if the saturation of the paragraph had been less than (0.50) is paragraph is deleted (Hair et al, 2017:113).
For the purpose of evaluating the measurement model for the research variables ((CM), (SQ)), the Smart-Plas program had been used to assess the validity and reliability of the measures used, as shown below:
1. Evaluation of the (CM) variable measurement model: Table (4) shows the results of evaluating the measurement model for the (CM) variable, which showed that all dimensions achieved the values required for the standards of validity and reliability of the scale, as shown below:
For the purpose of evaluating the measurement model for the research variables ((CM), (SQ)), the Smart-Plas program had been used to evaluate the validity and reliability of the measures used, as shown below:

Table (4) Results of evaluating the measurement model for the (CM) variable

Seq.	Dimensions	Cronbach's Alpha	Composite Reliability	AVE
1	Security	0.975	0.979	0.836
2	Performance	0.960	0.966	0.757
3	Regulation	0.957	0.963	0.746
4	lCost	0.953	0.960	0.729
Independent Variable: CM		0.983	0.984	0.758

Source: Smart-Plas3 outputs

2. Evaluation of the (SQ) variable measurement model: Table (5) shows the results of evaluating the measurement model for the (SQ) variable, which showed that all dimensions achieved the values required for the standards of validity and reliability of the scale, as shown below:

Table (5) Results of evaluating the measurement model for the (SQ) variable

Seq.	Dimensions	Cronbach's Alpha	Composite Reliability	AVE
1	Data	0.964	0.972	0.873
2	Analytics	0.972	0.978	0.900
3	Applications	0.967	0.975	0.885
4	Communication	0.965	0.973	0.877
Dependent Variable: SQ		0.983	0.984	0.629

Source: Smart-Plas3 outputs

Fifth: A test for the normal distribution of the research variables:

This part included the presentation of the test (Kolmogorov-Smirnov), to identify the nature of the distribution of the data of the research variables. The test resulted in Table (6) showing that the level of statistical significance for both variables amounted to (0.200), which is higher than the standard level (0.05), meaning that it is not significant, so all data of the two variables are subject to a normal distribution that depends on the use of parameter statistics. in analysis and testing.

Table (6) the test (Kolmogorov-Smirnov) for research variables.

Tests of Normality			
	Kolmogorov-Smirnova		
Dimensions	Statistic	df	Sig.
CM	0.068	73	.200*
SQ	0.067	73	.200*
. *This is a lower bound of the true significance.			
a. Lilliefors Significance Correction			

Source: Spss v28 output

Sixth: Descriptive Analysis of Research Scale:

This part included the presentation of the most important measures of central tendency and dispersion of research variables ((CM), (SQ)). The extent of the responses was determined in light of the arithmetic averages by determining their affiliation with any category. The research questionnaire is based on the five-point Likert scale (strongly agree-strongly disagree). There are five categories to which the arithmetic averages belong. The category is determined by finding the length of the range (5-1=4), then (4/5=0.80), then (0.80) is added to the lower limit (1) and subtracted from the upper limit of the scale (5), and the categories are as in the table (7).

Table (7) Statistical Description of Scale Categories

Category Seq.	Categories	Level
1	1 - 1.80	Very low
2	1.80 - 2.60	Low
3	2.60 - 3.40	Moderate
4	3.40 - 4.20	High
5	4.20 - 5.00	Very High

Source: Prepared by the researcher based on (Dewberry, 2004)

1. Descriptive Analysis of (CM) Variable Data:

The variable consists of four main dimensions, as shown in Table (8).

Table (8) the most important measures of central tendency and dispersion (n = 74) for the (CM) variable

Main Dimension	Mean	Std. Deviation	Variance %	Relative importance %	Answer Level	Dimensional order
Security	4.340	0.721	16.61	86.80	Very High	1
Performance	4.289	0.658	15.34	85.78	Very High	2
Regulation	4.246	0.609	14.34	84.92	Very High	3
Cost	4.219	0.627	14.86	84.38	Very High	4
General Average of a Variable: CM	4.273	0.653	15.28	85.46	Very High	________

Source: Spss v28 and Excel 2016 outputs

Table (8) showed that the general average of the (CM) variable amounted to (4.273), a general standard deviation of (0.653), a general coefficient of variation (15.28%), and relative importance (85.46%), and a response level (very high). It could be concluded that the interest in (CM), as well as the table above, showed the availability of all dimensions in the company with a very high answer level, but it was found that the Security dimension ranked first in the degree of ordinal importance according to the answers of the research sample, and this indicated that the company paid great attention to the security and privacy of data in the company. As for the least dimension, it was the Cost.

2. Descriptive Analysis of (SQ) Variable Data:

The variable consists of four main dimensions, as shown in Table (9).

Table (9) the most important measures of central tendency and dispersion (n = 74) for the (SQ) variable

Main Dimension	Mean	Std. Deviation	Variance %	Relative importance %	Answer Level	Dimensional order
Data	4.340	0.621	14.30	86.80	Very High	1

Analytics	4.205	0.694	16.50	84.10	Very High	4
Applications	4.273	0.721	16.87	85.46	Very High	2
Communication	4.243	0.665	15.59	84.86	Very High	3
General Average of a Variable: SQ	4.265	0.675	15.82	85.30	Very High	___

Source: Spss v28 and Excel 2016 outputs

Table (9) showed that the general average (SQ) variable was (4.265), with a general standard deviation of (0.675), a general coefficient of difference (15.82%), relative importance (85.30%), and a response level (very high). The high interest in Service Quality, as well as the above table, showed the availability of all dimensions in the company with a very high answer level, but it was that the Data dimension got the first place in the degree of ordinal importance according to the answers of the research sample, and this indicates that the company paid great attention to the data in the company. As for less after, it was the share of after analyzed.

Seventh: Testing the research hypotheses:

1. Correlation test: The simple correlation coefficient (Pearson) had been used to test the hypotheses of the correlation between the research variables, and to judge their strength based on the strength of the correlation coefficient of the rule (Cohen, 1977). As shown in Table (10) below:

Table (10) Strength of Cohen's Base Correlation Coefficient

Category Seq.	Categories	strength of correlation
1	0.29 - 0.10	Weak
2	0.49 - 0.30	Medium
3	1 - 0.5	Strong

Source: Prepared by the researcher based on (Cohen, 1977)

Test First Main Hypothesis:

H0: (There is no significant correlation between (CM) with its dimensions and (SQ) in the researched company).

H01: (There is a significant correlation between (CM) with its dimensions and (SQ) in the researched company).

Table (11) Matrix of correlation coefficients between (CM) dimensions and (SQ)

Correlations						
		Security	Performance	Regulation	Cost	CM
SQ	Pearson Correlation	.812**0	.888**0	.872**0	.714**0	.907**0
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	<.001
	n	74	74	74	74	74
**. Correlation is significant at the 0.01 level (2-tailed).						

Source: Spss v28 output

Table (11) publishes the matrix of simple correlation coefficients (Pearson) between (CM) with dimensions and quality of service. It showed the sample size (74) and the type of test (2-tailed) and the sign (**) is shown on the correlation coefficient, which indicates that the correlation coefficient is significant at the level (0.01) and a confidence degree of (99%). The table also shows the value of the simple correlation coefficient between the two variables is (0.907**), and it indicates the existence of a positive correlation with a significant indication at the level (0.01) and strong (because it is greater than 0.50) between (CM) in its dimensions and (SQ), and this reflects the distinctive role (CM) on improves the quality of service for the researched company. Therefore, he rejects the main null hypothesis and accepts the alternative hypothesis, which states that **(There is a significant correlation between (CM) with its dimensions and (SQ) in the researched company).**

This hypothesis is divided into:

a. H0: (There is no significant correlation between Security dimension and (SQ) variable)

H1: (There is a significant correlation between Security dimension and (SQ) variable)

Table (11) showed that there is a positive correlation with a significant indication level of 0.01) and a strong (because it is greater than 0.50) between Security dimension and (SQ) variable, as the value of the simple correlation coefficient between them was (0.888**). Therefore, he rejected the main null hypothesis and accepted the alternative hypothesis which states that **(There is a significant correlation relationship between Security and (SQ) variable).**

b. H0: (There is no significant correlation between Performance dimension and (SQ) variable)

H1: (There is a significant correlation between Performance dimension and the (SQ) variable)

Table (11) showed that there is a positive correlation with a significant indication at the level (0.01) and strong (because it is greater than 0.50) between Performance dimension and (SQ) variable, as the value of the simple correlation coefficient between them is (0.812**). Therefore, he rejected the main null hypothesis and accepted the alternative hypothesis which states that **(There is a significant correlation relationship between Performance dimension and (SQ) variable).**

c. H0: (There is no significant correlation between Regulation dimension and (SQ) variable)

H1: (There is a significant correlation between Regulation dimension and (SQ) variable)

Table (11) showed that there is a positive correlation with a significant indication at the level (0.01) and strong (because it is greater than 0.50) between Regulation dimension and (SQ) variable, as the value of the simple correlation coefficient between them is (0.872**). Therefore, he rejected the main null hypothesis and accepted the alternative hypothesis which states that **(There is a significant correlation between Regulation dimension and (SQ) variable).**

d. H0: (There is no significant correlation between Cost dimension and (SQ) variable)

H1: (There is a significant correlation between Cost dimension and (SQ) variable)

Table (11) showed that there is a positive correlation with a significant indication at the level (0.01) and a strong (because it is greater than 0.50) between Cost dimension and (SQ) variable, as the value of the simple correlation coefficient between them is (0.714**). Therefore, he rejected the main null hypothesis and accepted the alternative hypothesis which states that **(There is a significant correlation relationship between cost dimension and (SQ) variable).**

2. Impact relationship test: The Simple Linear Regression model had been used to test the hypotheses of the impact between the research variables, as shown in the table below:

Table (12) matrix of simple linear regression coefficients between (CM) with dimensions and (SQ). independent variable

Simple Linear Regressions						
Independent / Dependent		Security	Performance	Regulation	Cost	CM
SQ	R	.8120	.8880	.8720	.7140	.9070
	R^2	0.660	0.789	0.760	0.510	0.823
	F	139.787	269.634	227.804	74.836	334.015
	F Tabular	7.034				

	B	0.706	0.845	0.895	0.712	0.959
	t	11.823	16.421	15.093	8.651	18.276
	t Tabular	2.3793				
Sig.<0.001			At the 0.01 level.			

Source: Spss v28 output

Testing second main hypothesis:

H0: (There is no significant impact relationship between (CM) with its dimensions and (SQ) in the research company).

H1: (There is a significant impact relationship between (CM) in its dimensions and (SQ) in the research company).

Table (12) published the matrix of Simple Linear Regressions between (CM) dimensions and (SQ). The table showed that (CM) explained (82%) of the changes in (SQ), and the remaining was explained by were her variables outside the current research model. While the table showed the calculated (F) value of (334.015) was greater than its tabular counterpart (F) of (7.034) at the level of significance (0.01), this indicates that the estimated research model was (significant). Also, the calculated (t) value, which amounted to (18,276), was greater than the tabular (t) which amounted to (2.3793) at the level of significance (0.01), meaning that the impact is also significant. The impact factor of (CM) on (SQ) was (0.959), that is, when (CM) changed by one unit, (SQ) changes by approximately (0.959). Therefore, it rejected the null hypothesis and accepted the alternative hypothesis, which stated **(There is a significant indication of an impact relationship between (CM) with its dimensions and the quality of service in the researched company).**

This hypothesis is divided into:

a. H0: (There is no significant impact relationship between Security dimension and (SQ) variable)

H1: (There is a significant impact relationship between Security dimension and (SQ) variable)

Table (12) showed that the Security dimension explains (66%) of the changes in (SQ), and the remaining (34%) is explained by other variables outside the current research model. While the table showed the calculated (F) value of (139.787) was greater than the tabular (F), and also the calculated (t) value of (11,823) was greater than the tabular (t) at a significant level (0.01). And the impact factor of Security on (SQ) appeared (0.706). Therefore, it rejected the null hypothesis and accepted the alternative hypothesis, which stated **(There is a significant indicated impact relationship between Security dimension and (SQ) variable).**

b. H0: (There is no significant impact relationship between Performance dimension and (SQ) variable)

H1: (There is a significant impact relationship between Performance dimension and (SQ) variable)

Table (12) showed that Performance dimension explained (78%) of the changes that occur in (SQ), and the remaining (22%) is explained by other variables outside the current research model. While the table showed the calculated (F) value of (269.634) greater than the tabular (F), and also the calculated (t) value of (16,421) appeared greater than the tabular (t) at a significant level (0.01). And the impact factor of Performance in (SQ) of appeared (0.). Therefore, it rejected the null hypothesis and accepted the alternative hypothesis which stated **(There is a significant indication of an impact relationship between Performance dimension and (SQ) variable).**

c. H0: (There is no significant impact relationship between Regulation dimension and (SQ) variable)

H1: (There is a significant impact Relationship between Regulation dimension and (SQ) variable)

Table (12) showed that Regulation dimension explained (76%) of the changes that occur in (SQ), and the remaining (24%) is explained by other variables outside the current research model. While the table showed the calculated (F) value of (227.804) greater than the tabular (F), and also the calculated (t) value that amounted to (15.093) was greater than the tabular (t) at a significant level (0.01). The impact factor of Regulation on (SQ) appeared (0.895). Therefore, it rejected the null hypothesis and accepted the alternative hypothesis that stated **(There is a significant impact Relationship between Regulation dimension and (SQ) variable).**

d. H0: (There is no significant impact relationship between Cost dimension and (SQ) variable)

H1: (There is a significant impact relationship between Cost dimension and (SQ) variable)

Table (12) showed that Cost dimension explains (51%) of the changes that occur in (SQ), and the remaining (49%) is explained by other variables outside the current research model. While the table showed the calculated value of (F) which was (74.836) greater than the tabular (F), and also the calculated value of (t) which reached (8.651) was greater than the tabular (t) at the level of significance (0.01). The impact factor of cost on (SQ) appeared (0.712). Therefore, it rejected the null hypothesis and accepted the alternative hypothesis that stated **(There is a significant impact relationship between Cost dimension and (SQ) variable).**

CONCLUSIONS:

Based on the foregoing, the research questions can be answered as follows:

1. What is the degree of availability of (CM) foundations in Asia Cell? Companies in Iraq in general, and the researched company in particular, lack sufficient understanding of the concept and requirements of (CM) and Industry 4.0. It is a modern concept. The companies don't have academic concepts and requirements for this concept. While the level of interest of the researched company in the concept of (CM) (85.64%).

2. What is the level of interest in the necessary foundations to improve (SQ) provided by Asia Cell? The concept of (SQ) has changed dramatically in light of technological changes, increasing awareness of the requirements and diversity of customers. Despite the emergence of great interest in the researched company for the concept of (SQ) reached (85.30%), it lacks new innovations in services and modern requirements for quality in general and service in particular.

3. The extent to which Asia Cell has adopted (CM) in the services provided? The company paid great attention to Data Security and privacy in (CM) (86.80%), as well as to data (SQ) (86.80%), as both dimensions ranked first in relative importance to the company's employees' answers.

In order to achieve the objectives of the research:

1. The research presented some concepts and intellectual foundations of the research variables in the Literature Review.

2. The statistical results revealed a significant correlation (0.907) between the two variables, elucidating the unique and effective role of (CM) on improving (SQ).

3. As well as, the statistical results showed a statistically significant impact of the variable (CM) in improving (SQ), as the effect coefficient was (0.959). This explains the company's interest in (CM) as it effectively contributes to improving (SQ) of service provided to the researched company.

The cognitive limits of the study were embodied in two main axes represented by the variables of the study (CM), (SQ). The roots of the first extended to the management of production operations and the second to quality management. While the spatial boundaries of the study extended in the company Asia Cell Iraq Karbala branch. And The physical limits of the study were the administrative and technical workers in the company. The time limits for the study were for the period from (25/4/2022) to (20/6/2022).

RECOMMENDATIONS AND FUTURE WORK:

Recommendations:

It offers some recommendations as follows:

1. Due to the novelty of the topic, it is necessary for the researched company to study the concept of (CM) in a deeper way, adopt its dimensions, and apply it in a studied scientific way, which is expected to increase the extent and impact of the company's work in many areas.

2. To not be limited by old concepts of (SQ) and to adopt the modern concept and its dimensions in light of Industry 4.0, as well as to provide new, more creative ways to provide the service in order to increase the company's competitive advantage.

3. It is necessary to pay more attention to cost in (CM) (84.38%), as it plays a major role in enhancing the company's competitiveness. And also analyses the (SQ) (84.10%) because it has a significant role in achieving conformity in quality. Both dimensions ranked last in the relative importance of the answers of the company's employees.
4. The results showed the lowest correlation between Cost and (SQ) (0.714), so the company must invest in technology to reduce costs, access common materials to s, and increase flexibility in design and manufacturing, which further improves (SQ) in its dimensions.
5. The results showed the lowest impact factor between Security and (SQ) (0.706). The company must provide a secure environment for data and control it from loss or penetration, and provide interfaces, protocols, and a secure encryption mechanism because it has a direct impact on (SQ) and its dimensions.

Future work:

The role of Cloud Manufacturing in enhancing Operations Performance, The role of Cloud Manufacturing in achieving sustainability, The role of industry 4.0 technologies in improving Service Quality of, and The role of the Internet of Things in raising Service Quality.

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Appendix (1)
Search Variables Scale

Cloud Manufacturing		
Dimensions	ت	**Items**
Security	1	The company provides a secure environment from any (breach, loss, leakage, hacking, phishing from competitors) of data in the cloud.
	2	The company controls data loss due to physical damage exposed to the cloud.
	3	Company provides compliance with data privacy laws and regulations with the country that provides the cloud (data location).
	4	The company provides secure cloud service interfaces and the ability to monitor.
	5	The company has the ability to protect cloud protocols from IP hacks and cloning.

	6	The company has knowledge of the security procedures used in the development of cloud service interfaces.
	7	The company provides a secure data transfer mechanism between the interfaces of cloud services.
	8	The company provides secure cloud service interfaces for remote access without affecting the encryption/ decryption mechanisms in the cloud.
	9	The company has the ability to provide an encryption mechanism for every type of data available on the cloud.
Performance	10	The company has the ability to expand when requiring additional cloud resources or services.
	11	The company provides a broadband network to collect and transfer data in real-time from manufacturing resources to the server.
	12	The company provides a continuous network that prevents system failures and continues to operate in the event of failure in some of its components.
	13	The company provides devices that ensure workloads are balanced when inquiring about the same cloud service.
	14	The company achieves system integration with all stakeholders' access to the cloud.
	15	The company provides an interoperable system that enables it to deal with different CAD formats and standardize data.
	16	The company provides adequate protection for the material resources of manufacturing, such as machinery.
	17	The company provides high responsiveness to address the demands faced by cloud service interfaces.
	18	The company provides the ability to move its data and software away from the cloud service provider.
Regulation	19	The company provides methods for secure credibility to access cloud services (contracts, partnership).
	20	The company provides administrative procedures that determine who can perform operations with data (create, access, disclose, transfer, destroy) through the cloud.
	21	The company controls the licenses to share manufacturing resources and the access of users of different levels to different resources.
	22	The company controls the amount of resources/ data that a user of cloud services can access.
	23	The company has tools to monitor and document the quality of service to control and ensure the quality of the cloud service.
	24	The company trains its employees on cloud services whenever it introduces new software.
	25	The company has standards for the interoperability of cloud services and on-premises infrastructure and an understanding of the responsibilities of each party.

	26	The company has the ability to flexibly deal with the changing cost of cloud services.
	27	The company provides standards to ensure performance, network availability, and security for each manufacturing supplier or service request.
Cost	28	Investing in information technology reduces the overall costs.
	29	The cost of accessing shared resources from any device, anywhere, at any time reduces costs.
	30	The cloud provides high flexibility in pricing (pay for service).
	31	The cost of moving to a cloud-based system requires high costs.
	32	The cloud requires additional services to deal with it and additional costs.
	33	Scalability is greater with the cloud (information system growth is easy) and costs are lower.
	34	The company has the ability to switch the cloud service provider in less time and cost.
	35	Changing the design/ manufacturing order from the service provider does not add new costs to the company.
	36	The company can recover cloud services after the occurrence of electronic accidents, which reduces additional costs.
Service Quality		
Data	1	The company has modern technologies to save big data for suppliers, processes, services provided, customers and others.
	2	The company has modern technologies to classify and organize the various data of different suppliers, services and customers.
	3	The company has systems connected between its departments to collect various data and access it quickly.
	4	The company has integrated systems that achieve the accurate flow of data between the different departments of the company.
	5	The company has modern technologies with international specifications to access various data from anywhere and at any time.
Analytics	6	The company's management takes the initiative and seriously considers the problems and suggestions of customers.
	7	The company has high-accuracy systems to diagnose the main causes of customer problems.
	8	The company's management is keen to reduce the waiting period to meet the requirements of customers.
	9	The company's management has the ability to anticipate the needs of customers and respond to them with high efficiency.
	10	The company's management focuses on creating new services inspired by an accurate diagnosis of customers' needs and desires.

Applications	11	The company has modern facilities and equipment with international specifications to provide the service.
	12	The company has the ability to improve the accuracy and responsiveness of forecasting future demand from suppliers.
	13	The company's management motivates employees to solve the problems facing customers in an appropriate and immediate manner.
	14	The company has the ability to track quantities, defects and problems in materials resulting from quality suppliers.
	15	The company has the ability to predict different scenarios and choose the best.
Communication	16	The company's management is keen to take advantage of initiatives in the workers related to the service.
	17	The company's management has the ability to know the performance of services during their life cycle.
	18	The company has advanced equipment to detect errors or failures during service provision.
	19	The company has the ability to know the people, services and equipment related to the service.
	20	The company benefits from data, people and processes connected together in operational processes.