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Review of the Research on Scientific Data Management in China Libraries

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Abstract

Scientific data management is a hotspot and an important research topic of libraries recently. It's helpful to grasp the latest developments and directions in this field and provide reference for our library to better carry out scientific data management services. This paper retrieves related papers collected by CNKI. (China Knowledge Resource Integrated Database) From the concept of scientific data management, management policies, service models, new talent needs, data literacy education, obstacles, etc. Analysis and summarize the research results of scientific data management in recent years. Scientific data management has attracted widespread attention from many China Information Science scholars. However, the current study still presents obvious deficiencies, slow development of scientific data management service model, lack of scientific data management policy system, introduction of new talent exists only at the theoretical level neglect of data and humanistic education. And put forward some suggestions on promoting the practice of scientific data management in China.

Keywords: scientific data, service modes, management policies, new talents, literacy education

1. introduction

With the transformation of scientific research environment into data-intensive, scientific data management research has gradually become a hot spot in the academic community in China. Regarding the content of Scientific Data Management, it refers to the overall coordination, scientific allocation, and integrated management of the scientific data generated in research activities. It involves the collection, classification, standardization, release, and sharing of various types of scientific data to form the concept, policy, specification, environment, measures, and systems to maximize the benefits of Scientific Research Data Resources (2013). The library is responsible for the exploitation and reuse of digital resources, has a natural connection with data management.

Therefore, Chinese scholars have explored how university libraries can participate in data management and data management services. This article intends to comprehensively discuss the important research literature of library scientific data management services in China in recent years. Summarize the research hotspots and latest developments in this research field and point out the insufficiency of research in this field. It is expected to provide a theoretical basis and reference for promoting library scientific data management services.

2. Bibliometric Analysis

2.1 Age Distribution Analysis

In the study of this field, the author uses CNKI China Academic Journal Network as the data source (and Wanfang Data and Weipu Chinese Sci-tech Periodicals database as a search supplement), Subject search is based on the keywords "Scientific Data Management", "Scientific Research Data Management", "Research Data Management" and "Data Curation". Because Scientific Data Management and Scientific Research Data Management are basically the same, (This article discusses the use of scientific data management throughout this article). According

to the subject "Library Information and Digital Library" group browsing, after processing the obtained data, a total of 476 related research papers were obtained, as shown in Table 1.

Table 1. Distribution of the Dates of Scientific Data Management Research Papers

Published year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Number of publications	2	3	3	5	11	43	60	77	122	115	35
Percentage	0.4%	0.6%	0.6%	1.1%	2.3%	9.0%	12.6%	16.2%	25.6%	24.2%	7.4%

Combined with Table 1, you can find in the five years from 2008 to 2012, only a few scholars in China have explored and thought about the internal mechanisms and paths of library scientific data management services. The number of papers published is relatively small, with an average of only 4.8 articles per year, indicating that research in this subject area is still in infancy. However, since 2013, the number of research papers in this field has started to increase rapidly. The average number of papers published in the field from 2013 to 2017 was 83.4, which is about 20 times higher than the previous five years. (In 2018, only the amount of data in May was incomplete. It does not mean that the number of research papers published in scientific data management has declined.) Although it is still unable to reach a level of research in a mature research field. But this shows that China's scientific data management research has been widely recognized and concerned by the library community. Through the author's statistics on the collection of 476 documents, it was found that 378 of them were included in the core journals, which accounted for 79.4% of the total number of documents issued. It can provide a rapid progress in the scientific data management field in China and excellent quality evaluation.

2.2 High-Yield Author Analysis

The author also summarizes the scholars who have a higher number of articles in this field The specific situation is shown in Table 2.

Table 2. High-yield Author List

No.	Names	Number of articles
1	SiLi	10
2	Wu Ming	10
3	Huang Ruhua	9
4	Meng Xiangbao	8
5	Wei Junchao	8
6	Deng Zhonghua	8
7	Shen Tingting	7
8	Qian Peng	6
9	Wei Haiyan	6
10	Hu Hui	6
11	Deng Lijun	5

The number of people who published 5 or more articles was relatively small, only 11 people. And only 2 people published 10 or more articles between 2008 and 2018. This shows that domestic scholars are less concerned about the sustainability of the topic, and the development mode of the library's scientific data management service is not easy to break through, it is difficult to obtain innovative research results. It also requires the scholars to pay more efforts to promote the development of the library's scientific data management.

2.3 High Cited Literature Analysis

In order to make the study more comprehensive, the author summarizes the top 10 articles cited, as shown in Table 3.

Table 3. High Cited Literature List

No.	Topic	The author	Published Journal	Times cited
1	The Initial Exploration on the Library in the Age of Big Data	Zhang Wenyan	Library and Information,2012,(6)	148
2	Scientific Data Literacy Education in Overseas Academic Libraries	Meng Xiangbao	Journal of Academic Libraries,2014,(3)	103
3	Data Curation: A New Development of University Libraries in the U.S.	Yang Helin	Journal of Academic Libraries,2011,(2)	99
4	Research on Library Scientific Research Data Management and Service Model	Li Xiaohui	Journal of Library Science In China ,2011,(5)	99
5	Research on Scientific Data Services of Libraries Based on Data Life Cycle Theory	Shi Ronghua	Library and Information Service ,2011, (1)	72
6	The Initial Exploration on the Library in the Age of Big Data	Liu Ming	Chinese Journal of Medical Library and Information Science,2013,(2)	67
7	Data Literacy Education: Expansion of Information Literacy Instruction in the Big Data Era	Huang Ruhua	Document, Informaiton& Knowledge, 2016,(1)	63
8	Trends and Challenges for Institutional Repositories	Zhang Xiaolin	Journal of Modern Information,2014,(2)	54
9	Data Curation and New Thoughts in Developing Institutional Repositories in U.S.Universities ———The Data StaR Example	Yang Helin	Journal of Academic Libraries,2012,(2)	53
10	Scientific Data Manangement and Service in University Library--A Case Study of Wuhan University Library	Liu Xia,	Library and Information Service ,2013,(3)	52

The 10 articles cited at the top of the list are shown in Table 3(The table shows only the first author). Among them, the author believes that the article "Library Scientific Research Data Management and Service Model Discussion" published by Li Xiaohui in 2011 is the most representative. This is a pioneering document prior to the "Scientific Data Management Heat", The author puts forward unique insights into the library's data management service model and has a certain influence and guiding significance on later scholars' research. The research themes of most of the highly cited literature focus on the construction of library data curation services, emphasizes the important role of libraries in scientific data management services. And using foreign libraries as specific reference cases, presented their own construction plan.

3. Scientific Data Management Services Research Analysis

Through reading the literature, the author found that the research topics of the scientific data management service focused on the concept category, service model, management policy, new talent needs, data literacy education, and obstacle factors etc.

3.1 Concept Category

At present, domestic scholars have no unified title for scientific data, and there are two expressions of "scientific data" and "research data", the definition of the concept of scientific data is also not uniform. Some domestic researchers discuss the definition of scientific data. For example, Si Li and Xing Wenming (2013) believe that scientific data refer to primitive data that reflect the nature, characteristics, and change laws of the objective world acquired through scientific and technological activities or through other means, and according to the needs of different scientific and technological activities, the system processing and sorting of various data sets. Qian Peng4(2013) explained the meaning of scientific data in terms of traditional environment and digital environment. He believes that under the traditional conditions, scientific data refers to scientific research data based on experimental observations, usually stored on paper carriers. Under the digital scientific research environment, scientific data refers to the digital representation of research objects and research processes, as well as detailed records of data at different stages of the research process. Lai Jianfei and Hong Zhengguo (2013) defined the scientific data from the true reliability of the data and believed that the scientific data refer to verified and reliable scientific research process data, semi-finished products, and achievement data. Li Xiaohui(2011) pointed out that scientific data are research data in digital form, including any data that can be stored on a computer during the research process, and non-numeric data that can be converted into digital form.

3.2 Service Mode

How to provide scientific research workers with the most professional scientific data management services is one of the most intense topics that domestic scholars are currently discussing. The specific services involved in the construction of scientific data management and sharing platforms, metadata services, research support services, and personalized services.

3.2.1 Scientific Data Management and Sharing Platform Construction

Chinese scholars have found through literature research and internet research on foreign universities' scientific data management and sharing platforms. The United States, the United Kingdom, and Australia are the countries that currently have relatively complete services in the construction of scientific data management and sharing platforms. Many ischool universities have built a scientific data management and sharing platform. Wei Junchao and Zhang Chunfang6(2017) researched and compared the functions of foreign scientific data management platforms and found that the platform functions mainly focused on user management, data management, and data services, and generally provided data management plans, data submission, collection, organization, storage, data sharing, and publishing services. Platform construction types are roughly divided into two types: institution-building and general scientific data management software. DataStaR and PURR can be used as excellent templates for self-built scientific data management platforms in colleges and universities. General scientific data management platform software can be divided into institutional library construction software. (such as Dspace, Fedora, etc.) and specialized scientific data management software (Dataverse, Nesstar, etc.), Yin Shenqin, Zhang Jilong, and Zhang Ying et al. (2013) compared several platform softwares in terms of system functions, metadata standards, and data online analysis functions, and concluded that Dataverse's comprehensive performance is relatively complete.

Compared with the popularity of the United States, Britain, and Australia in the scientific data management and sharing platform, the development of scientific data management services in China is relatively inferior. At present, only three universities in Wuhan, Fudan University, and Peking University have a solid scientific data management and sharing platform. Wuhan University's scientific data sharing platform for scientific research workers provides data organization, storage, and sharing services (2013). Fudan University Social Science Data Platform provides data management and online data analysis services(2015). The Peking University Open Research Data Platform is based on Dataverse, which provides scientific data storage, publishing, sharing, and management services (2016).

3.2.2 Metadata Services

Metadata is an essential tool for the library to participate in scientific data management activities. Providing selection and recommendation of metadata standards and elements is a basic service for library scientific data management. Huang Ruhua and Qiu Chunyan (2014) introduced the metadata innovation practice service of DataStaR platform of Cornell University. In DataStaR, there are only "dataset title", "dataset owner", "metadata and data acquisition permission", "publication target storage warehousing" four metadata elements must be typed or selected, others can be generated automatically or by default. Wang Hui, WITT M and Dou Tianfang (2015) comprehensively analyze the case of Purdue University's research knowledge base. It was found that PURR chose a standard integration scheme to form a metadata description framework and fill in an online form to obtain most of the description metadata elements by the author when submitting data. Huang Xin and Deng Zhonghua (2017) discussed the metadata service content of scientific data in university libraries from the perspectives of the introduction, creation, consultation and training of metadata.

3.2.3 Research Support Services

Research support service as a service that runs through the entire scientific research process and is aimed at different stages of scientific research. Its own importance and necessity are increasing day by day. Li Mei (2017) proposed that domestic research university libraries should focus on the needs of scientific research users and integrate the resources of the entire library to conduct one-stop research support services. Huang Honghua and Han Qiuming (2017) analyzed the internet survey of 40 university libraries in Australia, their research support services were found mainly in the areas of institutional library construction, IT skills training, scientific data management, scientific influence measurement, scientific research ethics training, and scientific research publication. E Lijun and Cai Lijing (2015) proposed that domestic university libraries can start with investigating the actual needs of scientific researchers and actively explore the content of scientific research support services. Xiao Xiao and Lv Junsheng (2012) believe that the library's research support services should participate in the early planning and data modeling stage of e-research to ensure the long-term preservation of data and pay attention to the exchange and cooperation with various research groups.

3.2.4 Personalized Services

Personalized service is an important way to distinguish it from general services, showing the uniqueness of the organization and attracting long-term users. The key is to understand the real user needs, according to the characteristics of user needs,   to create high-quality services with high user satisfaction, good feedback, and continuous improvement. Wang Haibiao and Wei Junchao (2017) introduced the personalized data management plan service provided by the University of Edinburgh, provide users with DMPonline (a data management planning tool) and data management plan template. Li Wenwen and Cheng Ying (2017) proposed that the development of personalized scientific data management services for libraries should be based on the differences in information behavior characteristics of different disciplines. Focus on the selection of information sources, information retrieval, access and utilization, academic exchanges and cooperation.

3.3 Management Policies

Perfect scientific data management policies are the guarantee of scientific data sharing. Domestic scholars' researches on scientific data management policies are roughly divided into science and technology funding organizations policies and university policies.

3.3.1 Technology Funding Organization Policies

Si Li and Xing Wenming (2013) have found through research on science and technology organizations in the United States, Britain, and Australia that except for Australian government research funding agencies, there is no clear requirement for funding applicants to submit data management plans. The scientific research funding agencies of the United States (NSF, NIH, etc.) and the United Kingdom (six major councils) all require funding applicants to submit data management plans and specify the content and format of the plans. To ensure that scientific data generated during the research process can be effectively preserved and managed.

3.3.2 University Policies

Domestic researchers found that American universities first appeared in the policy of scientific data management. Ding Pei (2014) pointed out that most universities in the United States use scientific data retention, storage, and access policies to name scientific data management policy names. Wan Yan Deng Deng (2016) found that Australian universities pay attention to the revision and improvement of scientific data management policies. Most of the university's data policies registered on the national data service website have been revised or revised in the next 3-4 years. Deng Jia and Zhan Huaqing (2014) investigated and analyzed the scientific data management policies of Monash University, and found that its administrative policy level is clearly divided into three aspects: policies, procedures, and guidelines.

3.4 New Talent Needs

3.4.1 Data Librarian

Data librarians should act as the main force in the scientific data management activities to lead the development of related work, they have systematic and specialized training in data management, preservation and storage, and have professional qualifications (2012). They can assume corresponding responsibilities in the creation, preservation, analysis, supervision, and reuse of data.

Huang Ruhua and Li Nan (2016) proposed that data librarians have the ability to use data validation tools and manage scientific data. Guo Sang and Lin Wei (2017) expounded the post functions of the data librarians in university libraries from the perspectives of job titles, responsibilities, qualifications for employment, and attempts of domestic data librarians. Kang Xuqin, Chen Rui, and Cheng Jin et al. (2016) analyzed the key issues faced by domestic scientific data management and data librarian's development and put forward specific solutions about the establishment of a system, the establishment of positions, staffing, and upgrading of capabilities, and establishing support platforms, improve the process. Sun Liling (2017), based on the Framework of Research Data Librarian's Capability, believes that has the ability to provide access to data; the advocacy and support capabilities of data management; and the ability to manage data sets is the core competence of the data librarian's professional competence.

3.4.2 Subject Librarian

Subject Librarians, as an important link between the scientific research team and the library, undertake the important responsibility of integrating into the scientific research team and truly understand the real needs of scientific researchers. And timely feedback to the library to lay a solid foundation for providing good scientific data management services,   it plays an important role before, during and after scientific research.

Fan Aihong and SCHMIDLE D (2012) analyzed the nature and work content of the new subject librarians of

Cornell University Libraries. Get the development characteristics of the new role of the subject librarian: from service provider to academic partner; apply the latest information technology to the library; higher librarian skills and quality requirements. Hu Shaojun (2016) believes that subject librarians engaged in scientific data management work should be a kind of comprehensive high-quality talents, should have a sense of advanced data management services, integrate data and collections resource capabilities, data analysis and data mining capabilities, skilled application data platform capabilities, data management consulting and mentoring capabilities. Mu Xiangyang and Hong Yue (2015) took the entire life cycle of scientific data as the main line and explored the work content of subject librarians step by step, setting a new orientation for the role of subject librarians.

3.5 Data Literacy Education

Domestic researchers mostly mentioned user data literacy education during their learning of foreign scientific data management experience. Because the contents of the data literacy education provided by various colleges and universities are not the same, the author divides it into universal education for general users and more professional advanced education.

3.5.1 Universal Education

Meng Xiangbao and Li Aiguo (2014) introduced the general education curriculum for data literacy education in some European and American universities. The teaching methods are diverse, including elective courses, lectures, seminars, and online courses. The teaching contents involved include: basic concepts of data management, data management and analysis tools for specific operations and use, data management policies and ethics. Wang Weijia, Cao Shujin, and Liao Yunyun (2017) introduced the scientific data management course of the Oregon State University Library, which is mainly divided into six topics that scientific data types; metadata; data storage, backup, and data security; ethical and legal data for research data; share and reuse; long-term preservation.

3.5.2 Advanced Education

Liu Guifeng and Lu Zhangping (2016) conducted an on-site inspection of the University of Illinois at Urbana-Champaign and found that the university has set up a master's degree in data management. The research direction focuses on data collection, representation and management, digital preservation and archiving, data standards and policies. Si Li, Xing Wenming, Zhuang Xiaozhe, et al. (2015) conducted data literacy education surveys for iSchool colleges, among which the University of Michigan School of Information, Glasgow University, and the University of Illinois Graduate School of Library and Information Science had a master's degree related to scientific data management. North Carolina State University Chapel Hill offers data management certificates and curriculum programs and has developed doctoral programs and teaching networks for scientific data management. Wu Ming, Hu Huihe, and Chen Xiujuan (2016) believe that data literacy education should be carried out from four aspects that set teaching content from different disciplines; embed scientific research process to implement teaching; diversification of teaching forms; emphasis on curriculum assessment and feedback.

3.6 Obstacles

Domestic researchers started with internal and external environments and analyzed the barriers to library scientific data management services. For example, Peng Jianbo (2014), Huang Xin, and Deng Zhonghua(2016)believe that internal factors include inadequate financial support, lack of data resources, uneven quality of librarians, and backward technical conditions etc.Si Li and Xin Juanjuan(2014), Xie Chunzhi, and Yan Jinjin(2013), considered that external barriers include insufficient support for national policies, lack of relevant laws and regulations, and failures of various fund project authorities to make explicit requests etc. In addition, Zhou Lihong, Duan Xinyu and Song Yaqian (2017) also mentioned that the lack of design and planning services and single service methods in scientific data management services in domestic university libraries. Deng Lijun (2016) pointed out that there are problems such as limited education mode, lack of training education, and incomplete coverage of educational content in data literacy education. Zhu Caiping (2014) believes that existing service practices mainly remain at the shallow level of management of scientific data, and that there are serious shortcomings in the relevance and semantics of data that can improve the application and management of data.

4. Summary and Reflection

4.1 Summary of Scientific Data Management Research

4.1.1 The Lack of Development of Scientific Data Management Service Model

The author analyzes the contents of academic papers on the topic of scientific data management in China and finds that domestic scholars' research on scientific data management service models is generally based on the experience of foreign university's data management services. There is a problem of insufficient research on the service model

and operational flow of scientific data management. For example, there is no specific service that incorporates the characteristics of Chinese university libraries. Moreover, from the point of view of the established scientific data management and sharing platform, the author conducted research on it, in which the platform of Wuhan University cannot be accessed, and Fudan University and Peking University can normally visit, but these two platforms all contain data types that are single, the data volume is scarce, the update speed is slow, the content of many data spaces is empty, and the degree of encryption and sharing of data sets is low, covering a narrow range of subjects (inability to conduct interdisciplinary scientific research) and other issues. At the same time, the author learned through the literature research that the shared platform of Fudan University does not provide the use of statistical functions, unable to understand the true utilization of the platform, and is not conducive to the follow-up feedback and upgrade of scientific data management services. The author believes that the domestic scientific data management service model research still exists in the context of the data life cycle theory to carry out services, ignore the real needs of scientific research workers, ignoring the user's real needs, relying only on a theory to speculate, can not provide high-quality services that truly satisfy scientific researchers. Domestic scholars' research on foreign scientific data management service models is mostly based on access to databases. The actual utilization rate of the service in foreign universities is not clear.

4.1.2 Lack of Scientific Data Management Policy System

Data management policies play a decisive role in scientific data management activities. At present, the national level and the Science and Technology Funding Fund have not introduced mandatory relevant policies and regulations. Perhaps this is the fundamental reason for the slow progress of China's scientific data management policies. It does not prevent or affect domestic researchers from the bottom and consider the substance of the scientific data management policy. At present, few researchers have constructed specific scientific data management policy systems for domestic universities. Our country is in a society ruled by law, and it does not tolerate academic fraud. However, researchers in the study of foreign policy laws and regulations rarely deal with the punishment methods for providing false data.

4.1.3 New Talents Should not Only Exist at the Theoretical Level

Domestic researchers lacked practicality in the research of data librarians. According to the author's investigation, there is currently no library using the title of "data librarian". It can be seen that this research has so far been a purely theoretical idea without any actual action. I believe that the development of scientific data management services, data librarians are indispensable, this should not only be a good idea, should be on the agenda for the development of scientific data management services.

4.1.4 Neglect of Data and Humanistic Education

Domestic researchers in the field of data literacy education generally emphasize user's application of scientific data management operation technology, but they do not pay enough attention to data ethics, intellectual property rights, data citations, and data security education involved in data sharing. The author believes that the latter is the key to scientific data management. It is also the top priority for future academic development. Scientific data literacy education should not be limited to simple operations (such as browsing, uploading, saving, and downloading) that allow researchers to master data. On the level of use, more attention should be paid to standardizing its academic behavior so that scientific data can be used as a value-added function for a long time.

4.2 Reflections on Library Scientific Data Management

1.Focus on the real needs of scientific researchers. To provide scientific data management services (set up data management platforms), we must consider the true needs of researchers, starting with the survey questionnaires and monitoring their usual retrieval habits on public computers, and screen out data management platforms that facilitate the actual operation of scientific researchers. The use of statistical functions is added to the platform to provide late-stage user demand research based on utilization and to rationally improve platform services.

2. Provides characteristic data management services. Combining the characteristics of various disciplines in universities, it is targeted to provide scientific researchers with data sheets that are easy for them to fill out and facilitate operation.At the same time, it is necessary to combine the characteristics of professional disciplines, select metadata standards that already exist in the field or generally recognized in the field, and build a complete set of metadata solutions, and should continue to carry out research on the metadata resource description framework.

3. Launch linked data push services. Researchers in personalization services should work hard to provide data, documents and even images, videos, software, books, and push services that are similar to the topics of individual scientific data. Researchers should conduct in-depth research on the development of associated data to achieve

scientific data value-added.

4. Build a scientific data management policy system. Researchers should consider constructing a set of university data management policy protection systems. The leadership, science and technology departments, and library should be united. And should be specified in the policy system to reward and punish the mechanism, and data citations and solution to specific problems (may consider the preparation of DOI number for each scientific data).

5. Conduct regular field research. In the future, the study of foreign scientific data management experience should not be limited to simply accessing the external network database. Under conditional conditions, field visits should be conducted to gain an in-depth understanding of the real progress and dilemma of foreign scientific data management. Provide reference for the development of domestic scientific data management.

6. Set up data librarian posts. Libraries should gather talents, employ external talents with data mining backgrounds, or use regular training to cultivate internal librarians' data mining and data analysis capabilities, promote smooth flow of scientific data management operations, and provide more convenient services.

7. Develop data literacy education. Libraries shall, in conjunction with the heads of various departments, regularly hold data literacy education lectures in various departments or libraries or attach data literacy education courses regularly to the teaching of postgraduate and higher education courses. The contents should focus on data intellectual property rights. Scientific researchers clearly recognize that data ethics is a problem that cannot be ignored. Facilitate a more standard form of scientific data management.

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Cloud Computing of E-learning

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Abstract

With considerable improvement in Information and Communication Technology (ICT) field, many areas of our lives have been affected, including the learning environmentE-learning is one such inventions and is linked to the use of electronic methods to support the E-learning process, which has become increasingly popular and has become a strong trend due to the enormous benefits it offers to learning environments. However, E-learning systems and its management require huge investments in information technology, and many educational institutions don't have enough budget to afford the cost, therefore cloud computing is the finest solution. It provides an effective mechanism which can allow of building a new mode of E-learning system. This paper, discusses the features of the E-learning system, describes the strategy of Cloud computing, and analyzes the impact of using Cloud Computing in E-learning.

Keywords: e-learning, ICT, cloud computing, NIST

1. Introduction

Nowadays, ICTs play an essential role in the learning field. There are many models to get knowledge through Internet. One of the most favorable models in education field is E-learning. It indicates to the use of ICT in the network, allowing new opportunities for developing the education that have a strong effect on learning and teaching. Currently, no one can deny the popularity of E-learning in learning and teaching fields, regardless of time and space barriers (Dong, & Huang, 2011).

Other advantages have helped to accept E-Learning systems in countries including: the ease access to ICT, enormous growth in data, users, and resources (i.e. hardware and software), increasing flexibility, ease of access, convenience and availability of variety of courses, and reducing the training cost (Ajadi et.al, 2008, Fern´andez et.al, 2012).   Whilst there are many educational institutions cannot be adopting E-learning platform due to its huge investments in IT infrastructure (i.e. hardware and software) (Paul & Santhi, 2014).

To solve these problems, a key model has been emerging recently in the present century which is cloud computing. It is a new model for E-learning systems that providing suitable, on-demand access to a centralized shared pool of computing resources that can be deployed with great performance and minimal management overhead (El-Sofany et.al, 2013).

This model is a new technology which can improve universities functions in terms of students and academic staff services, and institutions themselves. Currently, the cloud computing is a trend that can solve the contradiction between the need to act quickly when experimenting new ideas and the slow traditional processes of planning and developing. The basic idea of cloud computing is to connect the computing resources as a service consumed by people, rather than a product that runs on their individual computers (Rădulescu, 2014).

This research is organizing as follows: E-learning architecture i.e. definition and its advantages have been explained in section 2. Cloud computing architecture has been discussed in section 3. Section 4 describes how can the cloud computing provide the E-learning systems with many services, and the conclusion in section 5.

2. E-learning Architecture

E-learning is an electronic learning, think of "E" as "Extended, Engaging, Energetic, and Exciting" learning (Luskin, 2012). Nowadays, it is widely used at different levels of education, like universal courses, firm trainings …etc. With the advent of handheld wireless devices (i.e. mobile phones, tablets and iPads), new terms are appeared such as "M-learning, which means the learner can learn in various environments using portable

devices rather than being restricted to a classroom or to a desk.

Liu in his research (Liu, 2010) provides the following definition of E-learning: "E-learning uses the Internet or other digital content for learning and teaching activities, which takes full advantage of modern educational technology provided with a new mechanism of communication and resource-rich learning environment to achieve a new way of learning".

Many research studies have been addressed the various issues that are related to E-learning in higher education system. Some of researchers defined E-learning (OECD, 2005), Sambrook, 2003), as "communication and learning activities through computers and networks (or via electronic means)". Fry (Fry, 2000) provided more specific definition; "delivery of training and education via networked interactivity and a range of other knowledge collection and distribution technologies." Wild, Griggs and Downing (Wild et.al, 2002) also had the same definition as Fry's – they defined E-learning as "the creation and delivery of knowledge via online services in the form of information, communication, education and training". Bleimann (Bleimann, 2004) stated that E-learning is a self-directed learning based on technology, especially web-based technology.

As shown in Figure 1, the architecture of an E-learning system is distributed system, consisting of two essential components: hardware and software. The hardware can be servers, communication infrastructure, and client device which can be PC, mobile, or tablet. The software consists of database, applications, and client application which can be dedicated application or web browser (Pocatil, 2010).
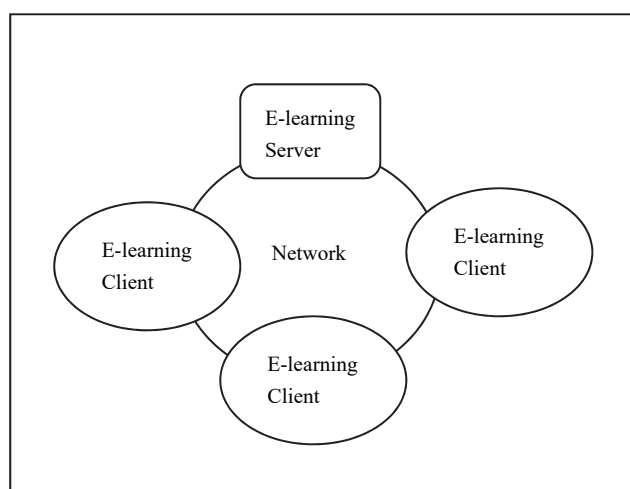
Figure 1. E-learning System

E-learning includes communication tools (i.e. synchronous and asynchronous), learners tracking, and assessment and collaboration techniques (Sneha & Nagaraja, 2013). E-learning is enhanced learning process based on ICT tools that are used to improve the online activities. There are basically four types of E-learning systems: Learning Support System (LSS), Learning Content Management System (LCMS), Learning Management System (LMS), and Learning Design System (LDS) (Ismail, 2002).

Based on the literature review (Allen, 2011, Roy and Raymond, 2005) the E-learning has many advantages, some of them are listed below:

• Saving money: In E-learning, there is production and small implementation costs only, no cost for production, set up, delivery, nor travelling.

• Accessibility: The students can access the material anywhere and anytime without worrying of missing important information.

• Affectivity: The E-learning has different learning styles and the students can choose their learning styles through variety of media (i.e. presentations, video, audio, etc.). In addition to, the student can replay some segments.

The review of some previous work in E-learning field (Almarabeh et.al, 2014, Guoli & Wanjun, 2010, Karim & Goodwin, 2013, Kerres & Witt, 2003) shows the resources of E-learning systems are the most important challenges facing the universities. It is important to understand that the cost in E-learning related to the maintenance of hardware (servers, computers, data centers, computing centers ...), and software which means the university has to pay for the site license, installation, and the technical support. (Kwan et.al, 2008, Arabasz et.al, 2003).

There are at least two users involved in an E-learning system: the teachers (i.e. uploading the course description, assignments and projects, assessing them and sending feedback, preparing exams and communicate with the students through forums...etc.), and the students (i.e. taking the courses online, downloading and uploading the assignments after solving, and taking exams...etc.).

3. Cloud Computing Architecture

Cloud computing is an important modern term in many fields. It doesn't refer to specific technology so it has many definitions (Schubert et.al, 2010). IEEE Computer Society defined Cloud computing as: "A paradigm in which information is constantly stored in servers on the Internet and cached temporarily on clients that include desktops, entertainment centers, computers, notebooks, handhelds, etc." (Kho, 2009). It provides the delivery of computing as a service not as a product, where by shared resources; software and information are produced to computers and other devices as a metered over a network.

The National Institute of Standards and Technology (NIST) defined it as: (The National Institute of Standards and Technology, 2011): "Cloud computing is a model for enabling convenient to access to networks and applications quickly, common set of configurable computing resources (e.g., networks, servers, storage and applications) that can work with little or interfere with the service provider to provide or be released immediately." Berkeley RAD Lab provided another definition (Armbrust et.al, 2009) is "cloud computing refers to both the applications delivered as services over the Internet and the hardware and systems software in the datacenters that provide those services. The services themselves have long been referred to as Software as a Service (SaaS), so we use that term. The datacenter hardware and software is what we will call the cloud".

As shown in figure 2, the cloud computing has three widely referenced service models.
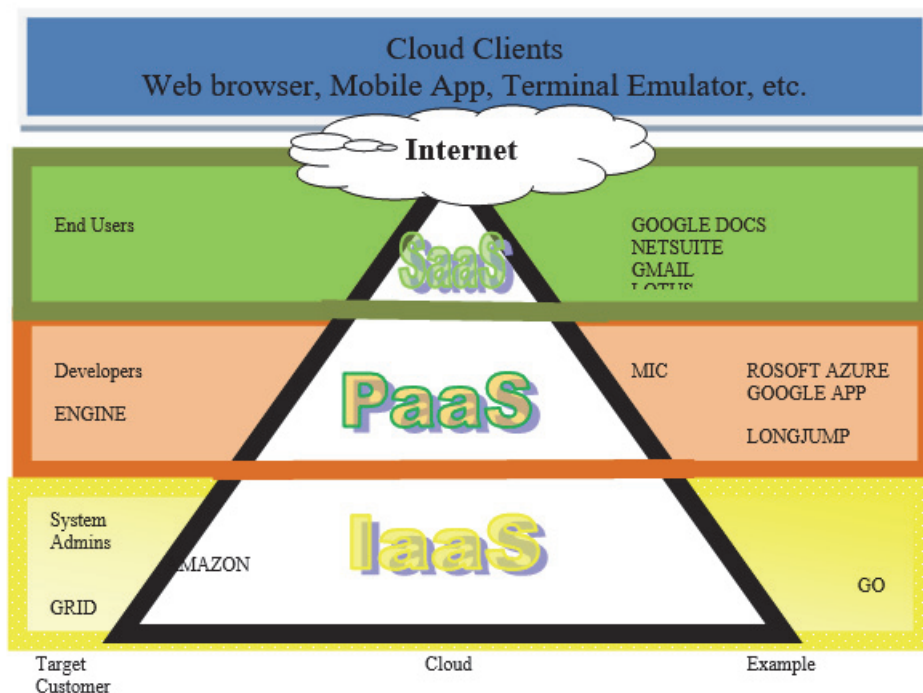
Figure 2. Models of Cloud Computing

1) Infrastructure as a Service (IaaS): The resources (servers and storage) are offered as services to customers so the businesses rent the resources rather than spending money to buy.

2) Platform as a Service (PaaS): Provides required platform to develop and customize applications.

3) Software as a Service (SaaS): Software applications are offered as services, like: Email, customer relationship management (CRM), instant messaging (IM), and office applications.

In addition to these service models, four deployments have been added (Almarabeh & Majdalawi, 2017):

1) Public Cloud: the storage, cloud applications are made available to the public by a service provider. These services can be free or offered on pay-per-use.

2) Private Cloud (also known as internal cloud): means the cloud infrastructure specified for a particular organization which it is not shared with other organizations. Private clouds are more expensive but also more secure when compared to public clouds.

3) Community Cloud: means sharing computing infrastructure between several organizations from a specific community.

4) Hybrid Cloud: These Clouds are a composition of two or more clouds (i.e. public, private, and community) to take the advantages of multiple deployment models such as increasing the flexibility of computing. The costs are spread over fewer users than public cloud (but more than private cloud).

The models of cloud computing offer enormous benefits to institutions such as reduced infrastructure costs, unlimited data storage, recovery, backup, and ease access to information. On the other hand, the cloud computing has disadvantages as follows (Micheal, 2009):

✓   The Internet connection: The internet is an essential component for cloud computing. In some regions there is no internet which means the user can't access anything (i.e. applications, documents... etc.). Therefore, using the cloud computing there is impossible.

✓   Limit the accessibility: In the regions that suffer low speed connections (i.e. Dial-up services), cloud computing will degrade the performance because it requires stable and fast connection to work with the large files and web-applications that need a lot of bandwidth to download.

✓   Data security: In cloud computing, data is stored in the cloud. This means the data is just as secure as the cloud is. If an unauthorized user can access the cloud, he/she will also have access to stored data in the cloud. In addition to the need for backups.

✓   Cost: On the long term, the data center subscription fee can be more expensive than buying the hardware; also the data will be accumulated massively to make it difficult to control.

4. Relationship between E-learning and Cloud Computing

In the present information age, ICT plays an important role in transforming how knowledge and skills are transferring to students rather than traditional face-to-face approach. There is need to redesign the delivery of educational system in response to the changing world as influenced by advancement in ICT (Baniwal, 2013).

These two systems together provide an environment where the user only requires a portable device which can be mobile, tablet, PC, etc. The main elements of E-learning are hardware, software, and platform. The cloud computing can facilitates them. Users can get/put data on the cloud from any place at any time. The primary characters tics of the relationship between them: resource pooling, on-demand self-service, broad network access, etc.

Many universities can't run the E-learning system due to the needed infrastructure and the resources. This is the reason of why Moodle and Blackboard have versions of cloud oriented base applications.

The trend towards the cloud computing because of low costs in terms of: development and technical support teams cost, periodic backup cost, and total project expenses. (Ahmed &Fouad, 2015, Akin et.al, 2014, Al Zoube, 2009, Rao, 2010).

A study conducted by (Ahmed &Fouad, 2015) showed a comprehensive comparison between E-learning system before and after moving onto Cloud to see the contribution of E-learning standards with the Cloud standards. The result supports the moving on to Cloud Computing environment because it is used as solutions to delivery of computing as a service rather than a product. Table 1 shows the comparison between the traditional E-learning architecture and E-learning architecture based on Cloud computing (Masud &Huang, 2009, Gamundan et.al, 2013, Pocatilu et.al, 2009).

Table 1. From Traditional E-learning Network to Cloud E-learning

Service	Traditional E-learning	Cloud E-learning
Acquisition Model	Buy Assets	Buy Service
	Build Technical Architecture	Architecture Include
Business Model	Pay For Assets	Pay for Use
	Administrative Overhead	Reduced Admin function
Access Model	Internal Networks	Over the Internet
	Corporate Desktop	Any Device

Technical Model	Single tenant, non- shared	Multi-tenant , Scalable, and Elastic
	Static	Dynamic
Delivery Model	Costly, Lengthy Deployments	Reduced Deployments time
	Land and Expand Staffing	Fast ROI (Return On Investment)

E-learning cloud is "a migration of cloud computing technology in the field of E-learning, which is a future E-learning infrastructure, including all the necessary hardware and software computing resources engaging in E-learning. After these computing resources are virtualized, they can be afforded in the form of services for educational institutions, students and businesses to rent computing resources" (Poonam & Sulke, 2014). Figure 3 shows E-learning cloud architecture.

Figure 3. E-learning Cloud Architecture

The architecture can be divided into five layers:

1) Infrastructure layer: This layer is located in the lowest level of cloud service middleware like physical memory and CPU. It is a dynamic and scalable physical host pool.

2) Software resource layer: offers a unified interface for E-learning developers, composed of Operating system and middleware.

3) Resource management layer: This layer achieves loose coupling of software and hardware resources.

4) Service layer: It is containing three levels of services (software as a service (SaaS), platform as a service (PaaS), and infrastructure as a service (IaaS)).

5) Application layer: Provides content production, content delivery, virtual laboratory, collaborative learning, assessment and management features.

The E-Learning systems face many challenges, and many previous researches provide some possible solutions to overcome these challenges (Poonam & Sulke, 2014, Viswanath et.al, 2012, Patel & Chaube, 2014, Al Ajmi, 2014, Dong et al., 2009):

✓ Lack of appropriate infrastructure: Many universities can't adopt the E-learning systems because E-learning needs rich multimedia and high resource requirements like storage, and bandwidth. In Cloud computing, data is created and accessed in the cloud, so no need for users to have digital devices (mobile, PC, Tablet) with large memory or high specifications. They can run the applications from cloud through their devices. Regarding the universities, they need to pay for each use and for the space they need only.

✓ Lack of maintenance and technical support: Many universities do not have highly qualified staff to support their own infrastructure and respond to network interruptions or security threats. In cloud computing there is centralized infrastructure which will reduce the needed time for responding to the issues. In addition to, E-learners will get the updated programs immediately because the programs are updated in the cloud.

✓ Change Management: The changing to an online system like E-learning will effects on all users like teachers, students, and technical staff. So the changing process isn't easy and the users need to recognize the value of such system and utilize it in their daily lives. Clouds provide wider access to E-learning users (i.e. access from anywhere), and the content of E-learning can be deployed and distributed quickly.

There is an important issue regarding security is cloud computing where the remote servers can be crash for some reason without warnings. Regarding this point, no need to worry about because the cloud computing provides some central security benefits for users and organizations that are using/developing E-learning as follows (Aljenaa, 2011):

✓ It is impossible to locate the machine that stores important data (i.e. exam questions and results).

✓ The primary part of the applications and data is stored into the cloud so it is not a major problem to lose the cloud client. Any new client can be connected quickly, and the observation of data access is easier than the traditional ways.

✓ Quick replacement of a compromised cloud located server without large costs or damages. It is very easy to create a clone of a virtual machine so the cloud downtime is expected to be reduced highly.

5. Conclusion

E-learning is a rapid and effective way to spread knowledge to learners in all countries in the world but need huge investments in IT infrastructure. The Cloud Computing is an attractive solution to provide services with minimal cost. It can reduce the costs due to low requirements of hardware and software, less need for onsite maintenance, and easy deployment across multiple locations. The limitations of cloud computing are represented by internet low speed which can adversely affect the performance of services in E-learning. Day by day, the internet speed and stability are continuing to be improved, therefore the popularity of cloud computing will be supported.

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The Comparative Effect of Air Pollution Caused by Greenhouse Gases Emissions on the Health of Men and Women in the Upper Middle-Income Countries

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Abstract

Greenhouse gas emissions and air pollution is a heterogeneous, complex mixture of gases, liquids and particulate matter and one of the major problems in the world which threatens the health of individuals and although this factor alone does not lead to death, it is very dangerous by affecting the progress and the progress speed of some diseases. Given the importance of health, in this paper, the effect of greenhouse gas pollution will be examined on the health of men and women in 33 upper middle-income countries from 2000 to 2016 in the form of panel data. The research results show that during the period studied, greenhouse gas pollution had a negative and significant effect on the health of men and women in the countries studied, but its effect on women's health was more than that of men.

Keywords: air pollution, Greenhouse Gas Emissions, Health, Panel Data Model

JEL Classifications: I10, Q01, Q53

1. Introduction

Air pollution include a heterogeneous mixture of solid and liquid particles suspended in air that varies continuously in size and chemical composition in space and time (Brook, Robert D., et al. 2004) And process that introduces different pollutants into the atmosphere that reason harm to humans, other living organisms, and the natural environment (Kinney, 2008; Brauer et al., 2012. Kim et al. 2015). These pollutants are associated with increased hospitalization (Poloniecki, Jan D., et al.1997) and mortality due to cardiovascular disease (Pope III, C. Arden, et al. 2002, Pope, C. Arden, et al. 2004, Samet, Jonathan M., et al. 2000) especially in persons with congestive heart failure, frequent arrhythmias, or both (Mann, Jennifer K., et al. 2002).

Air pollution has deleterious effects on both physical and mental health. (Fotourehchi, 2016) More than two million deaths per year are the direct result of air pollution through damage to the lungs and respiratory system (Shah et al. 2013). they were strongly associated with the industrial structure and development stage of a country. the economic recession period could function as a perfect timing for the reduction in air pollution level and the mortality induced by pollution (Chen et al. 2016).

Particulate matter (PM) is a key indicator of air pollution brought into the air by a variety of natural and human activities.

Carbon dioxide is responsible to %58.8 of greenhouse gas emission that has adversely influences on health status, it is toxic to the heart and causes diminished contractile force. (Muchopadhyay and Forssell, 2005, Davidson, 2003)

great in number scientific studies have explained particle exposure as the source of various health problems including premature death in people with lung disease and decreased lung function, irregular heartbeat, nonfatal heart attacks, aggravated pursiness, and increased respiratory symptoms such as coughing, irritation of the airways, or difficulty breathing (Atkinson et al. 2010; Cadelis et al. 2014; Correia et al. 2013; Fang et al. 2013; Meister et

al. 2012)

2. Literature Review

Fang et al. (2013) estimated that about 5% of lung cancer deaths and 3% of cardiopulmonary are ascribable to Particulate matter globally. Correia et al. (2013) suggested a possible relation between decrease in fine particulate matter and improved life expectancy based on data collected from 545 counties in the U.S. During the 2000- 2007. Their studies represent that a decline of 10 μ g m−3 of PM2.5 should have led to an increase of life expectancy by 0.35 years on average. Cao et al. (2011) perform a study to investigate the association between air pollution and mortality in 70,947 middle-aged men and women of the China National Hypertension Survey and its follow-up study.

Substantial associations were found between air pollution levels and mortality from lung cancer and cardiopulmonary diseases. Krewski (2009) indicate that Exposure to PM2.5 reduce the life expectancy of the population by about 8.6 months on average.

The similar research was estimateed reflect the very significant role air pollution plays in cardiovascular illness and death. More and more, evidence demonstrating the linkages between ambient air pollution and the cardiovascular disease risk is becoming available, including studies from highly polluted areas.

3. Materials and Methodology

In this research an empirical model was used to examine the comparative effect of air pollution caused by greenhouse gases on the health indicators of Men and Women as below:

LMRM= α_i + β_1 LPM2.5 $_{it}$ + β_2 LCO$_2$ $_{it}$ + β_3 OTG$_{it}$ + β_4 SCM $_{it}$ +U$_{it}$	**(1)**
LMRW= α_i + β_1 LPM2.5 $_{it}$ + β_2 LCO$_2$ $_{it}$ + β_3 OTG$_{it}$ + β_4 SCW$_{it}$ +U$_{it}$	(2)

i = 1, 2,..., N and t = 1, 2,..., T denote number of countries (i = 1, 2,…, 33 (N)) and time period (t =2000, 2001,…., 2016 (T)), respectively. α are constants and β1, β2, β3, β4 are coefficients. U is the error term that are normally

distributed with zero mean and homoscedastic variance $U_{it} \Box\ d(0, \sigma_\varepsilon^2)$. All the variables in Eq. (1, 2) are in

logarithmic form. The main health status proxy variables in the both equations are Adult mortality rate men (MRM)

and women (MRW), is the probability of dying between the ages of 15 and 60-that is, the probability of a 15-year-

old men (women) dying before reaching age 60, if subject to age-specific mortality rates of the specified year

between those ages.

There are three different air pollution proxy variables that their data are available for the analysis: 1. Carbon dioxide CO2 emissions (metric tons per capita) that are mostly stemming from the burning of fossil fuel and manufacture of cements that through releasing toxic substance into environment lead to negative health effects. 2. Particulate matter PM2.5 country level concentrations (micrograms per cubic meter). Particulate matter concentrations refer to fine suspended particulates less than 2.5 microns in diameter that are capable of penetrating deep into the respiratory tract and causing significant health damage. 3. Other greenhouse gas (HFC, PFC and SF6) emissions are by-product emissions of hydro fluoro carbons, per fluoro carbons, and sulfur hexafluoride (OTG). In the both equations social factors such as education levels are represented for the estimation and school enrollment, tertiary (% gross), respectively. School enrollment, tertiary (% gross) of men in equation 1 (SCM) and women in equation 2 (SCW) are defined as total enrollment in tertiary educations, regardless of age, expressed as a percentage of population of official tertiary education age. It is seen that, levels of Gross enrollment ratio, significantly influence on CO2 emission and PM2.5 and other gas concentration of the countries (world Bank, 2016).

For this paper, data collected from 33 countries upper middle-income level in the period 2000-2016.This data obtained from World Bank and countries are Contains:

Albania, Algeria, Argentina, Azerbaijan, Belarus, Belize, Botswana, Brazil, Bulgaria, Colombia, Costa Rica, Croatia, Dominican Republic, Ecuador, Equatorial Guinea, Fiji, Guyana, Iran Islamic Rep, Jamaica, Kazakhstan, Lebanon, Macedonia, Malaysia, Mexico, Namibia, Panama, Paraguay, Peru, Romania, South Africa, Suriname, Thailand, Venezuela.

In this study we estimate the model by using panel data method. For using panel data model particular test method are used which will be discussed in this section. Before discussion about estimation and model analysis, it is necessary that why this study try to use the panel data method. In other words, are the countries -which are going

to be studied- homogeneous or not? If the countries are homogeneous Pool Data method can be easily used by ordinary least squares otherwise, the necessity of using panel data is required. In other words, based on statistical concept we have:

$Y_i = Z_i\delta + U_i$ Conditional Model

$Y_i = Z_i\delta_i + U_i$ Non-Conditional Model

$i = 1, 2, ..., N$

The statistics for testing the hypothesis is as follows:

$$F_{(N-1, NT-N-K)} = \frac{(R^2_{UR} - R^2_R)/(N-1)}{(1 - R^2_{UR})/(NT - N - K)}$$

Which N represents the number of country, K the number of explanatory variables, T the number of observations over the time. In this test (which is called as significance effects of group test) when null hypothesis rejected, using of panel data is required. For decision about using of Fixed Effects method or Random Effects method, it must be considered that fixed effect method is usually used when total population is considered and if samples selected from big population, random effect method will be better method (Baltagi, 2005, 2008).

Hausman Test is used for determining the method of estimation in panel data approach which its statistic is (H) with χ^2 distribution with K degree freedom (number of explanatory variables). If the null hypothesis rejected in the first test, the second test (Hausman Test) for the method of estimation in panel data methods will be used. In the Fixed Effects method, time aspect is not considered and only the effects which belong to each section of the time will be consider as individual effects. In the Random Effects method, time aspect is considered and the effects which belong to each section of the time will be consider as individual effects in the model. Hausman test statistic is as follows:

$$H = \frac{\dot{\beta}_{FE} - \dot{\beta}_{RE(GLS)}}{VAR(\dot{\beta}_{FE}) - VAR(\dot{\beta}_{RE(GLS)})}$$

This test is hypothesis testing of uncorrelated individual effects and the explanatory variables which based on this test the generalized least squares estimation (GLS) under the H_0 hypothesis is consistent and under H_1 hypothesis is inconsistent. These hypothesis are as follows:

H_0: E (u_{it}/x_{it}) =0

H_1: E (u_{it}/x_{it}) $\neq$0

The rejection of the null hypothesis implies that the test method is fixed effects (Baltagi, 2005, 2008).

Table 1.

<table>
<tr><td colspan="5" align="center">Chow test results for men</td></tr>
<tr><td>Fixed Effect Test(Chow)</td><td>Significance level $\times 10^{-4}$</td><td>F degree freedom</td><td>Calculated F</td><td>Result</td></tr>
<tr><td>Panel</td><td>(0.0000)</td><td>(29 , 68)</td><td>209.24</td><td>H_0 is rejected</td></tr>
<tr><td colspan="5" align="center">Chow test results for women</td></tr>
<tr><td>Fixed Effect Test(Chow)</td><td>Significance level $\times 10^{-4}$</td><td>F degree freedom</td><td>Calculated F</td><td>Result</td></tr>
<tr><td>Panel</td><td>(0.0000)</td><td>(29 , 68)</td><td>112.33</td><td>H_0 is rejected</td></tr>
</table>

Source: Research calculations.

Table 2.

<table>
<tr><td colspan="5" align="center">Hausman test for men</td></tr>
<tr><td>Hausman Test</td><td>Significance level $\times 10^{-4}$</td><td>χ^2 degree freedom</td><td>Calculated χ^2</td><td>Result</td></tr>
</table>

| Panel |)0.006(| 4 | 18.26 | H_0 is rejected |

Hausman test for women				
Hausman Test	Significance level $\times 10^{-4}$	χ^2 degree freedom	Calculated χ^2	Result
Panel	)0.000(	4	25.67	H_0 is rejected

Source: Research calculations.

Test results for both model indicate that a good model is panel data model with fixed effects.

Model Estimation Results:

Table 3.

Model results of the regression model for men

variable Method	C	LPM2.5	LCO$_2$	LOTG	LSCM	R^2	F statistic
Fixed Effects Model	6.56	0.036	0.07*	0.01	0.32	0.84	272.6
	(0.000)	(0.48)	(0.09)	(0.000)	(0.000)		(0.000)

* indicates significance at 10%.

Model results of the regression model for women

variable Method	C	LPM2.5	LCO$_2$	LOTG	LSCW	R^2	F statistic
Fixed Effects Model	5.8	0.003	0.12	0.01	-0.28	0.78	182.31 (0.000)
	(0.000)	(0.96)	(0.01)	(0.000)	(0.000)		

Source: Research calculations.

4. Results

As observed in Table (3), statistics value and probability level in the first model show that all coefficients, except PM2.5, are significant at 99% confidence level and carbon dioxide emissions, are significant at 90% confidence level. Particulate matter carbon dioxide emissions coefficient shows that, assuming other factors are constant, with an increase of 1 percent in Particulate matter carbon dioxide emissions, the mortality rate of men in the countries studied is 0.07%, and in addition, assuming other factors are constant, with 1 percent increase in the emissions of other greenhouse gases (HFC, PFC and SF6), the mortality rate of men increases by 0.01 percent.

The statistics value and probability level in the second model show that all coefficients, except for Particulate matter PM2.5 coefficient, are significant at the 99% confidence level. The carbon dioxide emission Coefficient shows that, assuming other factors are constant, with an increase of 1 percent in the carbon dioxide emissions, the mortality rate in women is 12 percent, and assuming other factors are constant, with 1 percent emission of other greenhouse gases (HFC, PFC and SF6), the mortality rate in women increases by 0.01 percent. In addition, indicating a good fit and the fact that the independent variables in the model's particles coefficient explain several percent of the dependent variable, the value of R^2 is 0.84 in the first model and 0.78 in the second model.

5. Conclusions and Discussion

Given the importance of health, this study aimed to investigate and compare the effects of air pollution from greenhouse gas emissions on the health of men and women in the upper middle-income countries including Iran.

Using panel data in the period 2000-2016, this study was conducted in which mortality rate of women and men was used as a health indicator. It was expected that as men stay longer outside and therefore are more exposed to air pollution it has a more damaging effect on their health, while the results showed that although greenhouse gas emissions significantly increase the mortality rate of women and men, its impact on women's mortality is more. Therefore, it can be said that environmental pollution, especially air pollution, will have a more negative effect on women due to their hormonal changes, regardless of skin, digestive, cardiovascular, pulmonary diseases and cancers.

Given the sensitivity of women, especially pregnant women, and the fact that air pollution will cause negative effects such as cardiac abnormalities, decreased IQ and fetal weight loss, and thus it will have negative consequences for the health of next generation; while the identification of health problems, including the effects of air pollution, should be prioritized, and fundamental measures should be taken to reduce pollutants, how to deal with this phenomenon should be taught especially to pregnant women and mothers and accurate information should be provided to them so that they refrain from going outside in urban open spaces on the days in which the air is polluted and consider fluids and foods including antioxidants and iron in their own diet. In addition, generally the identification and control of the sources of air pollution, urbanization control, the development of urban green space, the prevention of natural resource degradation, strict control and monitoring of the centers of technical inspection of vehicles, the development of public transport fleet, culture building and the development of equipment for measuring air pollutants can be effective in reducing air pollution and its harmful effects.

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Appendix

Redundant Fixed Effects Tests

Equation: Untitled

Test cross-section fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	209.244405	(29,68)	0.0000
Cross-section Chi-square	459.248364	29	0.0000

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	18.264224	4	0.0011

Dependent Variable: LMORT_M
Method: Panel Least Squares
Date: 07/01/18　　Time: 11:25
Sample (adjusted): 2000 2012
Periods included: 5
Cross-sections included: 30

Total panel (unbalanced) observations: 102

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LPM2_5	0.036441	0.051753	0.704121	0.4838
LCO2	0.071167	0.041822	1.701677	0.0934
LOTHER_GAS	0.010897	0.001692	6.439972	0.0000
LSC_M	-0.319606	0.021913	-14.58496	0.0000
C	6.567690	0.183347	35.82110	0.0000

	Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.852498	Mean dependent var	5.219650
Adjusted R-squared	0.848857	S.D. dependent var	0.410668
S.E. of regression	0.043349	Akaike info criterion	-3.177843
Sum squared resid	0.127784	Schwarz criterion	-2.302852
Log likelihood	196.0700	Hannan-Quinn criter.	-2.823529
F-statistic	272.6157	Durbin-Watson stat	0.996592
Prob(F-statistic)	0.000000		

Redundant Fixed Effects Tests
Equation: Untitled
Test cross-section fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	112.338447	(29,68)	0.0000
Cross-section Chi-square	396.776156	29	0.0000

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	25.676609	4	0.0000

Dependent Variable: LMORT_F
Method: Panel Least Squares
Date: 07/01/18   Time: 10:53
Sample (adjusted): 2000 2012
Periods included: 5
Cross-sections included: 30
Total panel (unbalanced) observations: 102

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LPM2_5	0.003345	0.065160	0.051332	0.9592
LCO2	0.125363	0.051682	2.425674	0.0179
LOTHER_GAS	0.013620	0.002103	6.476425	0.0000
LSC_F	-0.284615	0.025463	-11.17772	0.0000
C	5.897152	0.234283	25.17103	0.0000

	Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.798824	Mean dependent var	4.607342
Adjusted R-squared	0.783400	S.D. dependent var	0.419554
S.E. of regression	0.054055	Akaike info criterion	-2.736416
Sum squared resid	0.198694	Schwarz criterion	-1.861425
Log likelihood	173.5572	Hannan-Quinn criter.	-2.382102
F-statistic	182.3159	Durbin-Watson stat	0.597123
Prob(F-statistic)	0.000000		

Parameters for Public Space Architecture. Informal Commerce Dynamics, as an Opportunity to Stimulate Urban Scenarios. Case Study Cali-Colombia

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Abstract

In the last decades, the occupation of the pedestrian routes and in general of the public space in the city center of Cali Colombia, have been evidencing diverse phenomena, which to a great extent respond to the accelerated growth of the urban population, where the migrations that have occurred in the interior of the country (fruit of the social conflicts of the last decades), have particularly marked the realities. In Cali, on 10th and 15th streets, near the Government Building, the Palace of Justice and the Municipal Administrative Center - CAM, the public space in general terms has been stressed in a particular way, which has generated conflicts in the surfaces designed for the pedestrians, since they are occupied by vendors in the midst of the informality routines, forcing the pedestrian to use the automobile tracks being a notorious and interesting phenomenon, when observing the factors that produce it and using them as parameters in the design of architectural spaces that contribute to improvement.

Keywords: public space, street vendor, informal commerce, pedestrians

1. Introduction

The city of Santiago de Cali, founded in 1 536, is located close to the south-western Colombian coast on the Pacific Ocean (Figure 1), it is undoubtedly the most important urban center of Colombia in that region, ranking by number of inhabitants (close to 2.5 million), as the third city with the largest population after Bogotá and Medellin (Torres & Caicedo, 2015), demonstrating particular processes in recent decades, where the urbanization of the territory is one of the most important and constants phenomena. Within the main characteristics of the city, there is the warm, humid climate and the flat topography that accompanies the Cauca River Valley from north to south. From east to west there are changes in the topographic profile, since the presence of the western mountain range (within the Andes mountainous chain), makes the "Farallones de Cali" a particular element of the city landscape, where another important group of rivers are born, covering the urban and rural perimeter of the municipality of Cali, transferring differentiated landscape qualities.

The proximity to the port of   Buenaventura (2 hours, 117 km) over the Pacific has been a special factor in the city growth, which has generated a special bond between Cali and the port since the very colony in the XVI century (Pérez V., 2007), because of the difficult climatic conditions on the coast, Cali became a "dry port" (Zambrano & Olivier, 1993) giving a commercial character to the city activities (Vásquez, 1990), but also, conditioning the national and world economic and productive cycles, most of the social dynamics since centuries ago, generating complex phenomena within the consolidation process of the city. The routines described within the urban development scenario, have encouraged growth in an accelerated manner in some periods, for example in 1 918 along with Bogotá and Medellin (what was called the "golden triangle of Colombia") accompanied the coffee

bonanza (Zambrano & Olivier, 1993), which resulted in a major boost to urban development and where without doubt the construction of the railway opened in 1 915 (Nieto, 2011) was another factor that markedly transformed the territory, since the need of perimeters for the new population became a constant, marking the forms of the city up to the present time (Jordan & Simioni, 1998). The information previously given describes and also shows that many people settled in territories and nearby cities, were attracted by the conditions of Cali and sought in it better living conditions, promoting other phenomena such as migrations of "large magnitudes" (Banguero, 1980), which is still recognizable today; which at the same time produces a continuous mixture of cultures, which stresses in many ways the urban development of the city, by considerably expanding the spectrum of needs, since the heterogeneous characteristics of the groups that arrive multiply the variables and increase the sense of the basics in the visions of the state in its different scales of administration.
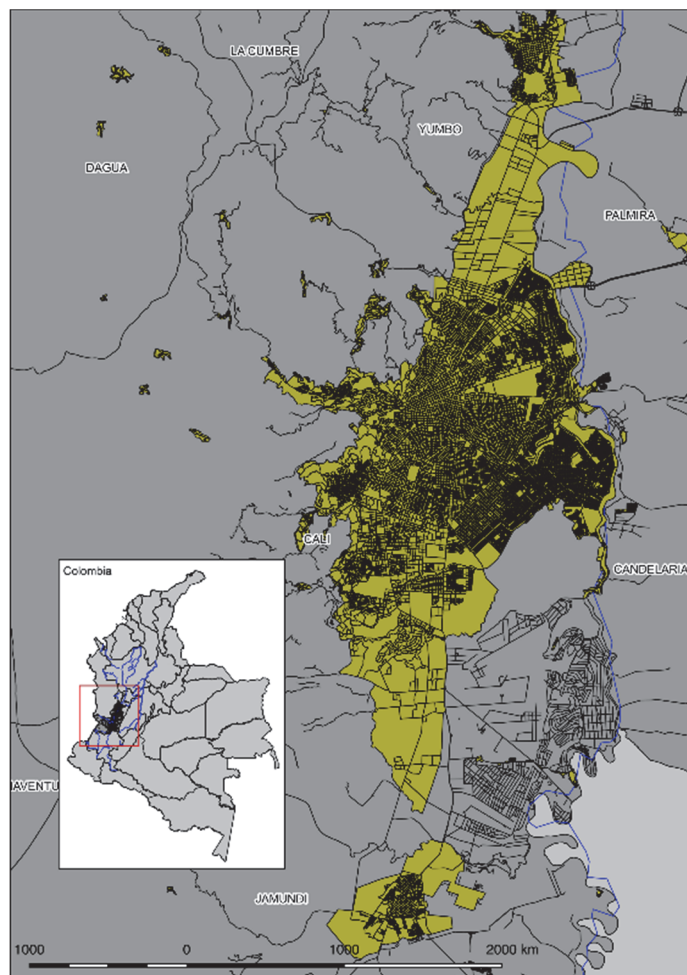
Figure 1. Location and urban layout of the municipality of Cali within the country and the region context.
Source: Own elaboration using Qgis

The phenomenon of multiple cultures reaching a territory in the induced migratory dynamics, ended up being decisive during the XX century (Urrea, 2011) and becomes transversal in the consolidation processes that we can study today, configuring a particular challenge, since being phenomena that is estrange to the traditional logics of urban development (Lombard, 2012) given in other areas of the country, escapes the standard planning lines and is aggravated by the centralist model of Colombia, becoming conditions that impact the dynamics of public management at a departmental and municipal scale (Cabeza, 1998), causing that the structured policies designed to respond to conflicts that manifest and take greater magnitude over time, have little effect when defining objectives or implementing investment programs, resulting in short-term decisions that lose strength quickly; leaving only for the purposes of the economic cycles the scenarios, being the agents that accelerate, decant and complicate the phenomena described in multiple ways previously. Result of these, the labor dynamics (without clear intervention of the state), is characterized by marked peaks of activity, and being the main motivator of

migration, causes that what we can call bonanzas, urbanization phenomena (formal and informal)) accelerate with all the associated consequences and in times of low performance, the purchasing power falls significantly, affecting the social routines, dramatically modifying the conditions of the recently settled population as occurred in 1 990 (Pérez et al., 2014).

These scenarios (apparently antagonistic), come along with direct effects on the way in which the city develops (understood as the process of consolidation of urban surfaces and nearby perimeters), emphasizing on the need to study the characteristics of the labor market to completely understand the ways of this development and this is where the informal characteristic of the labor market is framed as a little explored place and referenced within the context of the country.

The high informality of the last decades in Cali city (Bejarano, 2016), has caused the particular phenomena in the development to be defined in the ways of use of the surfaces (Group of Investigation Urban Processes in Habitat, 2009), firstly where the use of public space (especially the center of the city) is the opportunity to understand in a physical way what is stated up here in a theoretical way and placing as a basis that what today converges in a complex and confused way in a "dispute" (Arroyo & Burbano, 2014), it is a resulting phenomenon that must be seen in a different way starting from the characteristics that are displayed today (see Figure 2).

Figure 2. Invasion of sidewalks by informal vendors in downtown Cali. Photo by Edier Andres Segura 2016

The location of informal vendors in the public areas of the center, (designed and built for other purposes by the municipal administration), are transformed into "opportunity scenarios ", where activities can be developed to produce sufficient monetary income and subsist (Franco & Molina, 2015), for which there are specific characteristics that have to do with the location and the surroundings that facilitate commercial operations (Rocha, 2006), being observable parameters from the logic of localization and specialization of the activities that take place temporarily, what is a matter of interest for the research, to propose an experimental routine of geolocation of information, which is proposed as an analysis methodology. Therefore, the collection and structuring of the information is established as a starting point, starting with the characterization of the phenomena in aspects to relate and demarcate the patterns associated with the routines, which induce the use of the surfaces and generate conflicts to establish the conditions that appear in the phenomena.

2. Overview of the Study Area

The sector of the center delimited in the investigation (see Figure 3) is characterized by an informal trade under an already treated framework (Figure 4), which is already stationary, which is positioned on the pedestrian routes (platforms), generating forms of organization that respond to various logics such as: the type of merchandise that is commercialized, the proximity to main roads, the tolerance of the authorities and owners or that the surfaces are suitable to be used (among the most notorious at first glance), however the observation also evidences more complex organizational processes on which we want to investigate in detail and with other analysis tools. In a first approximation, the highest concentrations of street vendors occur between identifiable or significant nodes in the center's imaginary, which generate tensions of use, such as the CAM with the Palace of Justice (see Figure 5), transferring the phenomenon of tension to specific road axes such as: 12th and 14th streets with carreras 6th and 9th; where the informality already described, alter the mobility, (specifically the pedestrian in the case of

occupation of sidewalks), since the surfaces end up being occupied to develop the commercial activities.

By being arranged on measurable and identifiable road corridors, it is possible to observe informal trade and evidence specific conditions and characteristics, which can be structured in tables to see the relationships they cause and the public surfaces patterns of use by sellers that can be given. The type of commercialized merchandise and the number of sellers present in the road axes of interest are the first variables to structure information. When structuring the information of the variables presented in tables (see Table 1), it is seen that the fashion and accessories vendors are those that make the most use of pedestrian surfaces, which is of particular interest. By transferring this information already structured to other tools, it is possible to visualize localized relationships in the territory and see intensities that suggest changes in the special conditions, which represent other characteristics that can be unfolded to better understand the conditions that affect the use of pedestrian surfaces in the sector of interest.
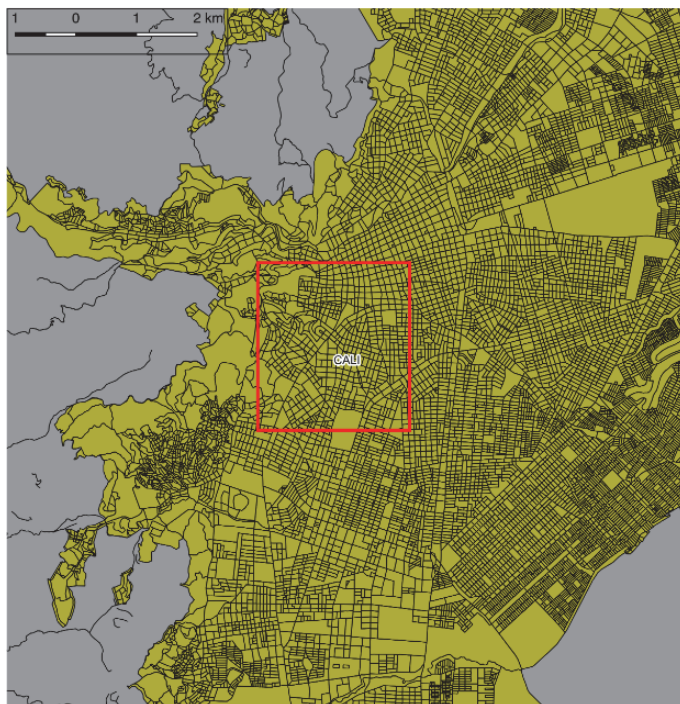
Figure 3. Perimeter of the traditional center of Cali. Source: self made

Figure 4. Invasion of sidewalks by informal vendors in downtown Cali. Photo by Edier Andres Segura 2016

Table 1. Quantity of informal vendors located on the sidewalks

Type of traded items	Number of informal vendors located on sidewalk
Food	51
Fruits and vegetables	37
Fashion	186
Accessories	150
Herbs	6
Gaming	23

3. Materials and Method

According to the considerations previously made, the relationships between the described variables can be defined in as follows: number of sellers, type of merchandise for sale (see Table 1) and location in the identified road corridors, using the ways of standard representation of geography as it is a map, but the amount of data that can be associated to these variables from attributes structured and collected in the field makes it possible to incorporate more variables into the analysis, allowing the study scenario to be more complex and visualize from other relationships the particular ways that induce the uses of public surfaces in the center of Cali city from the specific activity of informal sales.

Figure 5 as the first exercise to locate the characteristics of stationary informal trade in the center of Cali city shows dynamics and some logics that are the result of urban physical factors, which have to do, first of all, with the number of people and the type of uses of the buildings that frame the context of the activity, which according to the urban scale of the affected services transfers more or less intensity of use, such as the CAM node or the Palace of Justice node, which differentially affect nearby perimeters because they summon more (for the type of service provided in the city).
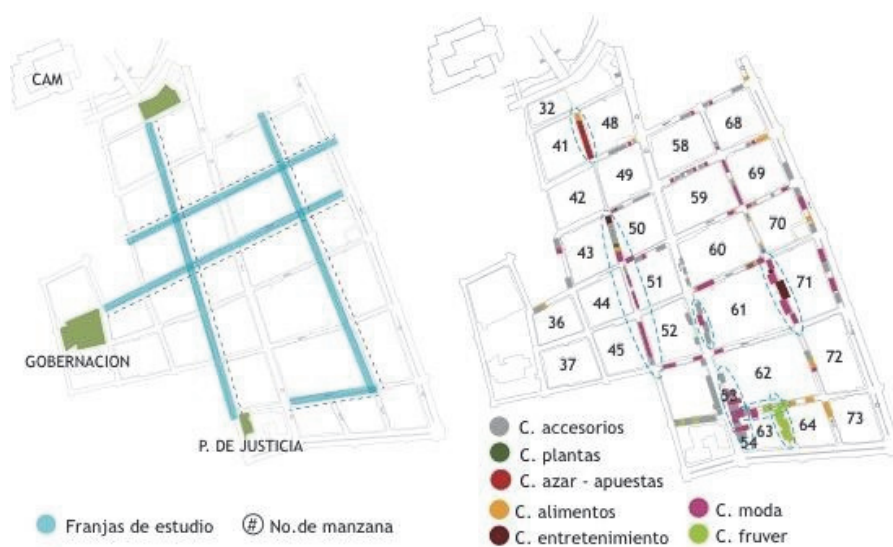
Figure 5. Location according to basic characteristics associated with the type of products for sale. Source: self-made

This condition (with respect to the differential way in which some nodes attract activity), allows us to understand that the "density of vendors" depends on the context where these nodes are located and that these have logics that are shaped by the circumstances associated with the use of the surfaces, therefore the "intensity of use" is a result that is transferred directly to the surface where the crossing is located and the magnitude with which it occurs is the same intensity already described. In this sense, the density and intensity (understood from the urban context), allows configuring the activity scenario, to be able to deform it and adjust it to the specific degree of use (intensity) and diminish the negative effects, such as the displacement of vulnerable road actors (such as pedestrians) and expose it by forcing it to compete for spaces at times of maximum demand or intensity of use.

The activity scenario of interest, under the parameters defined previously, are framed as the space to use information analysis methodologies, which are based on the data collection (which describe the observed characteristics), where geolocation must be the parameter of articulation, which as a node, will link the data, so

that as they unfold, incorporate or expand, they can be contrasted in different relationship scenarios and produce the characteristic facets (that explain from delimited methodological frameworks), the conditions and characteristics of the phenomenon, its degree of relationship and the magnitude with which it varies according to the change in the variables.

Therefore, the systematization of the relevant data will link the data with its spatial attributes to form the data packages and scenarios where the contrasts can be visualized. In this sense, Figure 5 is the basis of analysis to make the discrimination of the characteristics, where the use of the visualization tools developed by Google and where the data presented in the generalities, will be the methodological structure to study the phenomenon of confrontation by the public space, understood as the public surfaces of free and public use of decree 1504 of 1998 (Mayor's Office of Bogotá, 2012), in the sector of interest. The classification of the sellers in Table 1, shows a specialization in the first measurement of the sales that are made according to the offered articles, being something of interest since it allows to see logics in the distribution that surpass the supposed randomness that is intended to be associated from visions of the exercise of informality.

The Method section describes in detail how the study was conducted, including conceptual and operational definitions of the variables used in the study, Different types of studies will rely on different methodologies; however, a complete description of the methods used enables the reader to evaluate the appropriateness of your methods and the reliability and the validity of your results, It also permits experienced investigators to replicate the study, If your manuscript is an update of an ongoing or earlier study and the method has been published in detail elsewhere, you may refer the reader to that source and simply give a brief synopsis of the method in this section.

3. Results

When visualizing with heat maps, it is possible to observe with greater precision the patterns around specific places and the intensities that have been referenced and Figure 6 is the first resulting cartographic element, where the routines of interest are manifested in the road axes according to the direction of the nodes referenced but the intensities that show different patterns display a greater level of detail contributed by the tool and when contrasting with Figure 5 denotes other types of phenomena associated with the same data.
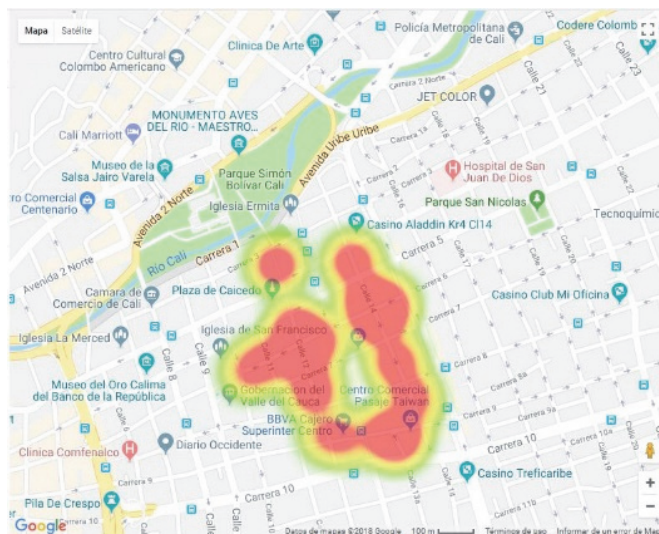
Figure 6. Road axes where informal street sales are characteristic in the Cali city center. Source: Own elaboration using Google tools

The use of the tool according to the structured and proposed methodology, allows to disaggregate and view the information, using as backup the sector map, with which it is possible to discriminate by type of sales, the variables defined as: intensity, density and magnitude of use of the surfaces according to the activity to delimit performance perimeters that adjust to the level of demand or the collateral uses that are presented. First of all, it highlights the specialization that occurs in sales according to what is marketed and the specific maps permit to visualizing it:

a. Figure 7 Affectation of pedestrian surfaces according to informal accessories sales.

b. Figure 8 Affectation of pedestrian surfaces according to informal food sales.

c. Figure 9 Affectation of pedestrian surfaces according to informal sales of gambling.

d. Figure 10 Affectation of pedestrian surfaces according to informal fashion sales.

e. Figure 11 Affectation of pedestrian surfaces according to informal sales of plants (herbs).

In the fashion accessories sales according to Figure 7, the 14th street between the Carreras 5th and 6th have the highest degree of intensity. The food sales in Figure 8 is placed on the road axis of the Carrera 6th between 10th and 11th streets. The sale of gambling in Figure 9, on 12th street between Carreras 3rd and 4th, the fashion sales in the streets 12 and 14 between the Carreras 7th and 8th Figure 10 and the plants and / or herbs sales according to Figure 11, 14th street between Carreras 5th and 7th.

In the developed research (by the methodology used and the addressed subject of interest), a detailed analysis of a sector of the center of Cali city is produced, where it is visualized (with the use of Google geolocation tools), the occupation of specific public spaces by the so-called informal vendors, where the pedestrian surfaces in particular, show a specific affectation, that today is understood as conflictive, by the competition for the use that is given by these urban surfaces.

Figure 7. Affectation of pedestrian surfaces according to informal accessories sales. Source: Own elaboration with Google tools

The densities and their magnitudes, which show the heat maps, allow us to understand that the informal commerce generated in specific places of the center, produce phenomena that respond to the type of merchandise that is commercialized, and with this, the first patterns from which little is known in the specialized literature. In this sense the labor informality that produces street sales has not been studied in depth from urbanism or disciplines that address the urban aspects, so many details and considerations that show the previous relationships have not been registered, so the degree of uncertainty regarding the actions taken by the municipal administration (in defense of the use), have side effects in sectors of the population that have few guarantees because the population is registered as vulnerable in the needs scenarios, which it is a counter-sense in all public policies, since these populations are the ones that should have the most guarantees within the framework of the administration's priorities.
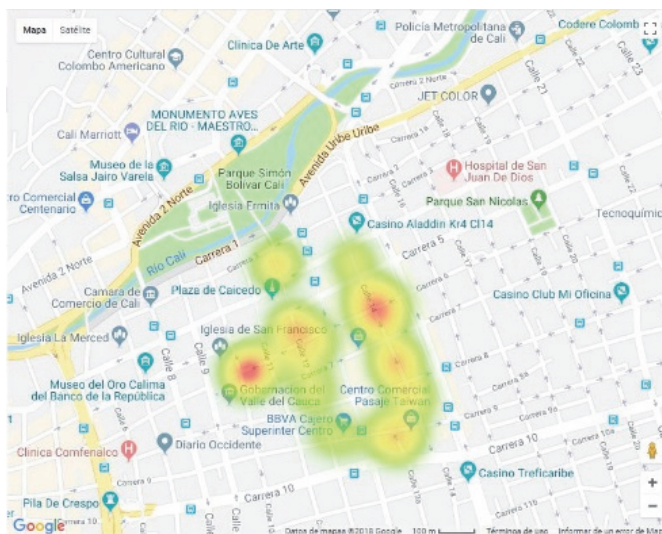
Figure 8. Affectation of pedestrian surfaces according to informal food sales. Source: Own elaboration with Google tools

Figure 9. Affectation of pedestrian surfaces according to informal sales of gambling. Source: Own elaboration with Google tools

The consolidation of the information in tables and maps in this research, generated a first diagnosis with an experimental methodology of a phenomenon that occurs in a sector of the city center, but also produced a matrix of characteristics to consolidate, to propose adjustments in the methodologies of traditional analysis, which when addressing the subject from generalized and standardized planning frameworks, induce negative collateral phenomena, with which adding attributes in the matrix that incorporate a greater degree of complexity in conflictive scenarios of public space use, is a result of great importance because it proposes other approach forms and alternatives to obtain results with the possibility of direct use in the design of both policies and urban projects in these sectors. The research suggests that it is necessary to rethink urban renewal projects (Gausa, 1997), which allow the humanization of public space in all its dimensions responding to time and its context, generating models that define social, environmental and economic strategies that make it possible to improve conditions of conflict and in this point the spectrum of opportunities that new tools of information management give with respect to the way of thinking about the city, should be incorporated.
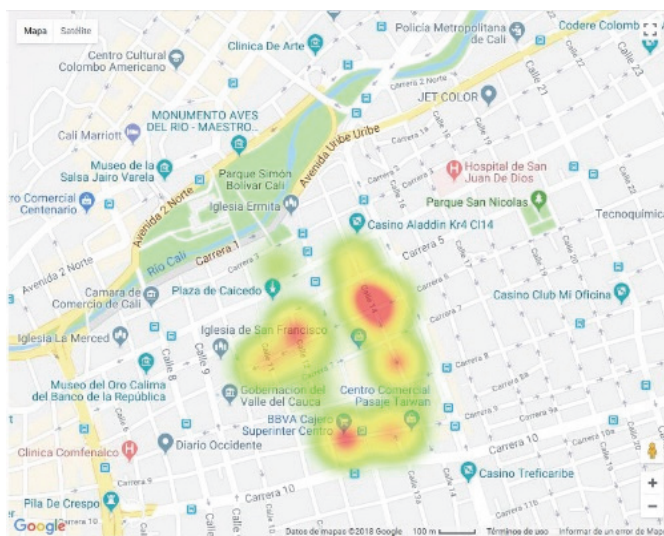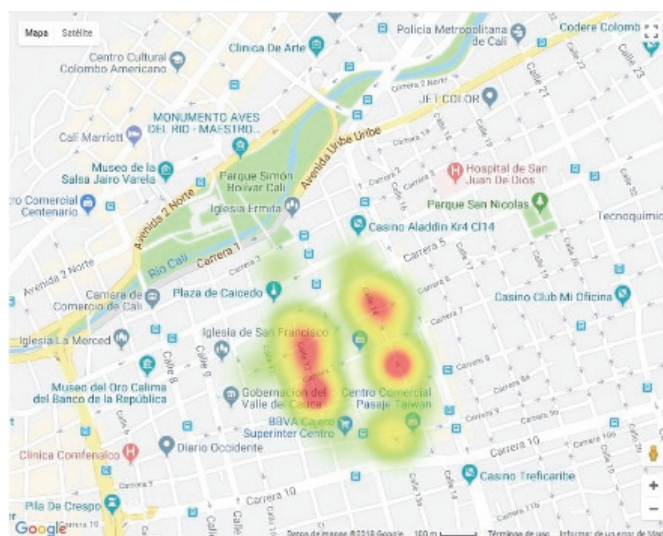
Figure 10. Affectation of pedestrian surfaces according to informal fashion sales. Source: Own elaboration with Google tools

5. Discussion

The elaborated maps allow to visualize that the urban surfaces used by the informal vendors in the city of Cali, present patterns that allow the characterization of the zones in a theoretical way and within the logic of proposing alternatives that give solution to conflicting routines associated to the use of the public space, it is possible that these patterns are guidelines to give specific answers, and from the adjustment of the same surfaces, (taking into account the specific factors of each scenario) to ensure the permanence of the actors in conditions of "use balance", which is defined as a concept to be designed in the instruments of territorial ordering and pertinent urban regulatory framework. It is interesting to see that the densities evidenced in the heat maps (Figure 7 to Figure 11), allow us to understand that there are distributions with specialization according to basic elements (as in the case of this study, the merchandise that is commercialized), with which the design of suitable places for the different practices (understanding from the point of view of architectural space), in a routine of providing space of labor opportunity is possible, adding variables of balance according to uses and immediate urban context, with which "the surfaces of opportunity "is a second concept that allows design to be incorporated as a planning tool.

This is a method that allows progress in the generic way in which the phenomena of informal vendors are understood today, where the common action forces relocations to solve the conflict, which produces collateral conflicts, such as when the vendors abandon the spaces delivered and return to the places from which they were originally displaced, which can be seen in cities such as Manizales, Pereira, Medellín, and Bogotá among others, evidencing waste and poor focus of the investments.

The specialization of product marketing routines, in the logic of informality, can be understood as an opportunity, in terms of allowing the facial association or cooperation, which produces a more agile management in decision-making and the rapprochement between actors. Which is undoubtedly a facet to be explored by the magnitude that has taken the phenomenon in different cities and proposes it as a way of participatory projects and empowerment of the administration of public surfaces with precise responsibilities among the actors that translates into continuity of the projects and the consolidation of trust with populations historically poorly treated by the state.

The strategies that the last public administrations of the city have implemented in response to this phenomenon have not been appropriate, and their measures are also based on relocation (in empty places in the commercial centers of the sector, or sent to Parque Comercial Rio Cauca, in the periphery of the city) where the minimum sales guarantees that would allowed them to have income, was not a factor associated with the project, which generated the returning of the premises and the vendors to return to their usual spaces, demonstrating punctually what was described in the first paragraphs.
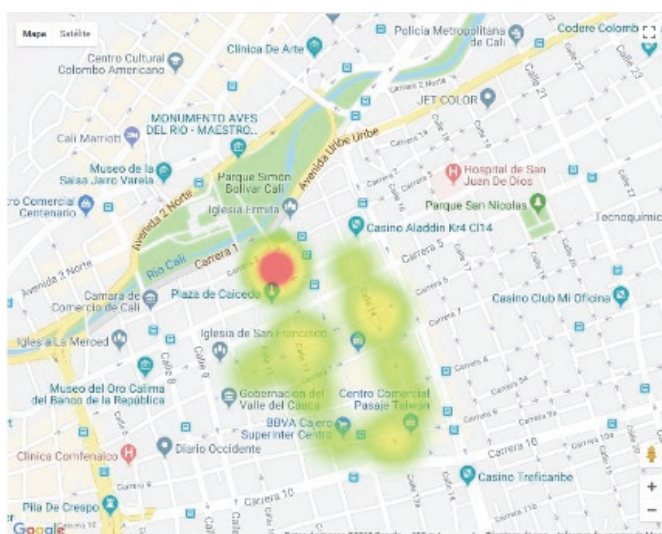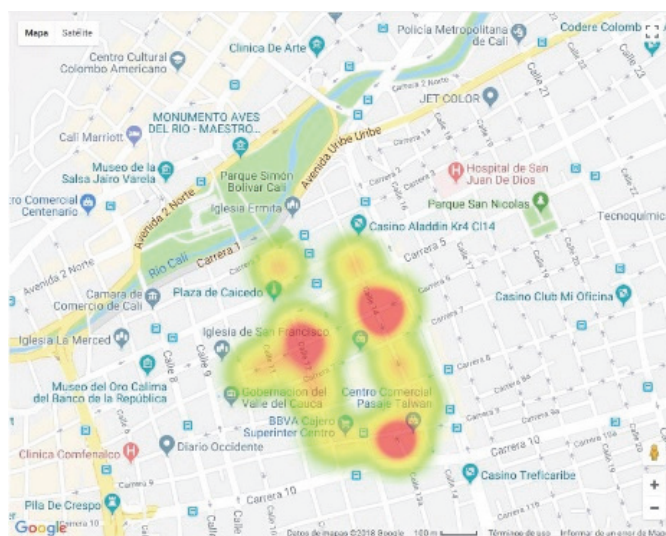
Figure 11. Affectation of pedestrian surfaces according to informal sales of plants (herbs). Source: Own elaboration with Google tools

6. Conclusions

A first general conclusion points out that at the time the Santiago de Cali center was planned, it was not thought to assume and respond to the phenomena caused by the current marked growth, which is why it has been facing dynamics that generate different alterations of the urban structure and especially in the oldest sectors; which translates into a contradiction, since sectors of the city with possible degrees of historical and patrimonial value are pressured with greater force (as in the case of Cali) facing phenomena typical of "modernity", such as automotive and use density.

By looking in detail at the phenomenon of stationary informal vendors in the Cali city center, one could quickly see the relationship between the presence of vendors and the proximity to significant and traditional urban nodes such as churches, plazas, parks or public buildings, and those nodes, having a relationship through road corridors generate tensions, it is possible to easily identify the different elements in relation that produce the phenomenon. In this sense, the road profiles are presented as a "space of opportunity" that, according to the precise adjustment that is made, allow the coexistence of different urban routines, without reaching conflicting conditions such as the one evidenced in the investigation with the invasion of pedestrian space.

The results of this research show the growth of informal employment in the city of Cali, which tends to subtract pedestrian surfaces, altering urban conditions of great importance. Because of this, it is proposed that many areas of the center should be reorganized according to the observed characteristics, and proposed as a process of "formalization" (according to the investigation), seeking to return the public space to the pedestrian in a practice that In recent years has been called "humanizing public space" (Ministry of Urban Development, 2009).

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The Analysis of Selected Posturogram Parameters in Children with Scoliotic Changes

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Abstract

The aim of the research was to analyze selected posturogram parameters in children with scoliotic changes. 28 girls aged 7-18 years old were involved in the study. Children attended to the Interschool Centre of Corrective Exercises in Starachowice. The research was conducted in June 2011. Spine research was made by *Exhibeon digital radiography.* Based on the size of the angle of spinal curvature there were identified scoliotic posture: 1-9° and scoliosis: ≥10°. There were 21 (75%) children with scoliotic posture, and 7 (25%) with idiopathic scoliosis. The frequency and type of defect *didn't depended on age.* Postural reactions were examined by static-dynamic Tecnobody's ST 310 Plus Stability System platform. Perimeter was from 539,46 with opened eyes (OE) to 759,04 with closed eyes (CE). The difference in Romberg's Test was 219,58. Ellipse area was from 447,46 with opened eyes (OE) to 850,32 with closed eyes (CE). The difference in Romberg's Test was 402,86. Perimeter ratio was 146,68, and Area ratio was 213,89. Analysis of variance showed a significant effect of study options which clearly differentiates Permeter (p=0,000008) and Ellipse Area (p=0,029882) in the research with opened and closed eyes. In a study with closed eyes it has been observed a significant increase of posturogram variables. Analysis of variance for Area ratio didn't show any significant effects (p= 0,376899) similarly for Perimeter ratio (p=0,523086). Posturogram variables generally decreased with age, however the analysis of variance didn't show any statistically significant effects. The analysis of the Spearman rank correlation of posturogram variables with age of examined persons also didn't show any significant associations.

Keywords: posturogram parameters, scoliotic changes, Tecnobody's Stability System platform

1. Introduction

The record which shows the way of the centre of feet pressure (COP) in a two-dimensional supporting plane is called posturogram or statokinesiogram. Most often assessed sway parameters are those, which are easiest to measure (Błaszczyk, 2016). The directions in this plane are determined by the letters x and y, wherein x (or AP) means sways in the sagittal plane, and y (or ML) lateral deflections in the frontal plane (Aroeira et al., 2016). The most frequently analyzed and probably the most valuable parameter of posturogram is the path length of posturogram. The road traveled by the center of gravity during the test, depends on the imposed time of registration and the speed movement of the COG (or COP) during the study (Michoński et al., 2016). Usually impaired balance control of standing posture is manifested by prolongation of this road (Nishida et al., 2016). Because the chaotic movements of the center of gravity are two-dimensional, additional informations about postural stability can be obtained, by analyzing the individual components of the way of statokinesiogram, separately sways in the sagittal plane, and separately in the frontal plane (Wilczyński & Ślężyński, 2016). Separate analysis of each component of posturogram allows to find, in which plane the instability intensifies. More information about the balance control provides the analysis of the entire envelope of posturogram, not just selected directions (Huec et al., 2016). If we

will connect the extreme points of statokinesiogram with the lines, we will get an irregularly shaped polygon. The area of a figure calculated by the computer, depends on the range of sways in all directions and it is the another characteristic parameter of posturogram (Park et al., 2016). More often, somewhat to simplify the problem of analysis, researchers fits the sway points into a circle or ellipse (Bogie et al., 2014). The geometrical dimensions of these figures, for example the radius of a described circle or length rays and tilt axis of the ellipse, are another important indicators of the quality of balance control (Tam et al., 2014; Pialasse et al., 2016). The posture of a man standing in a standard two-legged support is characterized by a greater sways in the sagittal plane (Pialasse & Simoneau, 2015; Yen et al., 2016). Movements of COG in the frontal plane are much smaller, and the increase of instability in this plane is usually effectively compensated by wider spaced feet (Khanal et al. 2016; Pialasse & Simoneau, 2014). The range of observed sways in the sagittal plane is usually two or three times greater than in frontal plane, and that's why the ellipse more accurately covers the measurement points of statokinesiogram (Park et al. 2013; Paolucci et al., 2013; de Santiago et al., 2013; Talić et al., 2016). In addition to the surface of the ellipse, an important indicator of the quality of balance control is the slope of a longer axis of the ellipse (corresponding to the sways in the sagittal plane) relative to coordinate system (Berdishevsky et al., 2016; Gomez, Hresko & Glotzbecker, 2016). Balance disorder, caused by scoliotic changes, in addition to the range increase of uncontrolled movements of the center of gravity of the body also causes characteristic changes seen in posturogram, for example the slope of axis of the ellipse (Yang et al., 2016; Seifert, Thielemann & Bernstein, 2016). The aim of the research was to analyze selected posturogram parameters in children with scoliotic changes on Tecnobody's ST 310 Plus Stability System platform.

2. Method

2.1 Participant (Subject) Characteristics

The study included 28 girls aged 7-18 years old with scoliotic posture and idiopathic scoliosis. All respondents were selected intentionally. All research procedures were carried out in accordance with the 1964 Declaration of Helsinki and with the consent of the University Bioethic Board for Scientific Research affairs at Jan Kochanowski University in Kielce (Poland). Children attended to the Interschool Centre of Corrective Exercises in Starachowice (Poland). The research was conducted in June 2011.

2.2 Research design

Spine research was made by ***Exhibeon digital radiography.*** Pixel Technology's Exhibeon digital radiology is a valuable diagnostic tool, which replace a traditional X-ray film. Exhibeon runs on Linux and Microsoft Windows operating systems. With a browser, we can describe changes in bone structure, and ***soft tissues.*** Exhibeon currently supports 84 graphic image formats, compatible with DICOM, including animation formats presented in CINE mode. Exhibeon is able to cooperate simultaneously with multiple image archives - PACS servers. The program supports the format DICOMDIR, and allows to search the images inside catalog. It allows printing on DICOM printers, and their configuration, through the base device, is simple. Exhibeon digital radiology allows, among others, to outline the central sacral vertical line, visible on X-ray of the spine on the computer screen, measure of the angle of axial circle rotation and to determine the Cobb angle. Radiographs have been taken of a free-standing position, anterior-posterior projection and lateral. With a browser, we could describe changes in bone structure, and ***soft tissues.*** X-ray included lumbar, thoracic and cervical spine, chest, and pelvis with hip joints. The Cobb angle has been marked on X-ray of the spine, which is visible on the computer screen. For the study of posturogram, the computerized posturography has been used. Posturogram variables were examined by static-dynamic Tecnobody's ST 310 Plus Stability System platform.

2.3 Measures and Covariates

The research based on continuous observation of the centre of feet pressure (COP). By recording the horizontal deflection of the body (postural sway) as a function of time, the detailed information concerning the postural system has been obtained. The COP displacements reflected the movements of center of body mass (COM) in the frontal and sagittal plane. The frequency of signal was 20 Hz. Change of the maximum pressure on the soles of the feet during the deviations of the body was perceived by mechanical-electronic transducer consisting of three sensors installed inside the platform. Recorded signal was processed from the analog information into digital, and then elaborated by computer program. The appropriate software created the possibility to calculate the resultant ground reaction force, which is the sum of the moments of the forces acting on the platform in three points of measurement. Vector addition of force moments allowed to designate the resultant ground reaction force at the moment, which is graphically presented as a dot on statokinesiogram. There was performed a standard stability rating test in a free-standing position (Romberg's Test). ***The test consisted of two successive samples*** lasting 30 seconds each: first with opened eyes (OE – *open eys*), second with closed eyes (CE– *close eys*). ***Measurements***

were taken in the morning. The tested person was carefully instructed about the test sequence. The ***silence has been assured*** during examination, because auditory stimuli acting on man ***in terms of attention*** can significantly impair the postural reflexes. The examined person has been ensured about the total harmlessness of the performed test. During the study, the investigator was behind the tested person all the time, not passing any messages. During the measurements with opened eyes (OE), the examined person has been asked to focus his sight on a point of reference located on the computer screen. The center of vision speckle was located at a distance of 1 meter from examined person. Before starting the test with closed eyes (CE), researcher made sure that the tested person is able to maintain an upright posture without visual control. The examined person stood on a platform barefoot, because shoes could interfere his posture. The feet were set with careful precision: heels 2 cm from each other, feet apart at the angle of 30 °, so that the center of gravity of a polygon base was in the sagittal axis of the platform at a distance of 3 cm from its center. To facilitate the correct positioning of the tested person, the platform was equipped with a pattern to keep the feet apart. The examined person took a habitual position with arms lowered along the torso and head straight. Test started at the time when investigated person took a posture, and on the screen the way of centre of feet pressure deviation was displayed. It has been analyzed the selected posturogram parameters, which records the centre of feet pressure deviations (COP):

− Perimeter. It is the total length of the path traveled by the COP in both planes during the oscillation (mm).

− Ellipse area. It is the total area which circled the COP in both planes during the oscillation (mm^2).

− Perimeter ratio. It is the ratio of circumference (perimeter) with eyes closed (CE) to the circumference with eyes opened (OE) in Romberg's Test.

− Area ratio. It is the ratio of ellipse area with eyes closed (CE) to the area with eyes opened (OE) in Romberg's Test.

Depending on the compatibility of variable distributions with normal distribution, and the value of skewness and kurtosis, parametric or non-parametric tests have been used. Variables were verified in terms of normal distribution by Shapiro-Wilk test. Variability of quantitative traits in terms of categorial features (age group, study options) were verified by analysis of variance with single and double classification. The level of significance was p <0,05.

3. Results and Discussion

Based on the size of the angle of spinal curvature there were identified scoliotic posture (1-9°) and scoliosis (≥10°). There were 21 (75%) children with scoliotic posture, and with idiopathic scoliosis 7 (25%). The frequency and type of defect ***didn't depended on age.*** Perimeter was from 539,46 with opened eyes (OE) to 759,04 with eyes closed (CE). The difference in Romberg's Test was 219,58. Ellipse area was from 447,46 with opened eyes (OE) to 850,32 with closed eyes (CE). The difference in Romberg's Test was 402,86. Perimeter ratio was 146,68 and Area ratio was 213,89 (Tab. 1).

Table 1. Posturogram parameters with eyes opened (OE) and closed (CE)

Postural reactions	n	Average	Med	Min	Max	Range	Standard deviation	Skewn	Kurtos
Perimeter (OE)	28	539,46	493	248	1079	831	195,80	1,272	1,825
Ellipse Area (OE)	28	447,46	438,5	102	1660	1558	314,37	2,260	**7,616**
Perimeter (CE)	28	759,04	723	449	1330	881	232,50	0,714	-0,106
Ellipse Area (CE)	28	850,32	647	144	3776	3632	781,18	2,525	**7,165**
Perimeter ratio	28	146,68	140,5	71	226	155	36,45	0,271	-0,338
Area ratio	28	213,89	187,5	31	719	688	149,03	1,691	3,896

Perimeter in the age group of 7-11 was from 659,00 with opened eyes (OE) to 830,00 with closed eyes (CE). The difference in Romberg's Test was 171. In the age group of 12-14 was from 483,53 with opened eyes (OE) to 756,61 with closed eyes (CE). The difference in Romberg's Test was 273,08. In the age group of 15-18 was from 506,71 with opened eyes (OE) to 682,42 with closed eyes (CE). The difference in Romberg's Test was 175,71 (Tab. 2).

Table 2. Perimeter and Ellipse Area in age groups

Independent variables	(OE-CE)	Dependent variable				n
		Average	Standard error	-95,00%	95,00%	

7-11 years old (1)	Perimeter (OE)	659,00	66,05	522,96	795,04	8
7-11 years old (2)	Perimeter (CE)	830,00	83,00	659,04	1000,95	8
12-14 years old (3)	Perimeter (OE)	483,53	51,81	376,82	590,25	13
12-14 years old (4)	Perimeter (CE)	756,61	65,11	622,50	890,72	13
15-18 years old (5)	Perimeter (OE)	506,71	70,61	361,28	652,14	7
15-18 years old (6)	Perimeter (CE)	682,42	88,73	499,67	865,18	7

Independent variables	(OE-CE)	Dependent variable				n
		Average	Standard error	-95,00%	95,00%	
7-11 years old (1)	Ellipse Area (OE)	681,87	101,24	473,36	890,38	8
7-11 years old (2)	Ellipse Area (CE)	892,87	281,12	313,89	1471,85	8
12-14 years old (3)	Ellipse Area (OE)	362,84	79,41	199,27	526,41	13
12-14 years old (4)	Ellipse Area (CE)	965,61	220,53	511,42	1419,80	13
15-18 years old (5)	Ellipse Area (OE)	336,71	108,23	113,81	559,61	7
15-18 years old (6)	Ellipse Area (CE)	587,57	300,53	-31,38	1206,52	7

Ellipse area in the age group of 7-11 was 681,87 with opened eyes (OE) to 892,87 with closed eyes (CE). The difference in Romberg's Test was 211. In the age group of 12-14 was from 362,84 with opened eyes (OE) to 965,61 with closed eyes (CE). The difference in Romberg's Test was 602,77. In the age group of 15-18 was from 336,71 with opened eyes (OE) to 587,57 with closed eyes (CE). The difference in Romberg's Test was 250,86 (Tab. 3).

Table 3. Perimeter Ratio and Area Ratio in age groups

Independent variables	Perimeter Ratio Average	Confidence -95,00%	Confidence 95,00%	n	Perimeter Ratio Standard deviation	Min.	Max.
7-11 years old (1)	134,87	105,36	164,38	8	35,30	71	181
12-14 years old (2)	156,92	133,43	180,41	13	38,87	108	226
15-18 years old (3)	141,14	111,13	171,15	7	32,44	102	183
Total	146,68	132,54	160,81	28	36,44	71	226
Independent variables	Area ratio Average	Confidence -95,00%	Confidence 95,00%	n	Area ratio s	Min.	Max.
7-11 years old (1)	174,87	83,64	266,10	8	109,12	31	337
12-14 years old (2)	248,38	133,10	363,66	13	190,76	63	719
15-18 years old (3)	194,42	110,55	278,30	7	90,69	92	326
Total	213,89	156,10	271,68	28	149,03	31	719

Total Perimeter ratio was 146,68. In the age group of 7–11 was 134,87, in the age group of 12–14 was 156,92, and in the age group of 15–18 was 141,14. Total Area ratio was 213,89. In the age group of 7-11 it was 174,87. In the age group of 12–14 it was 248,38, and in the age group of 15–18 was 194,42. The analysis of variance with the single classification showed a significant effect of study options in Romberg's Test (OE/CE) both for Perimeter ($p=0,000008$) as well as Ellipse area ($p=0,029882$) (Tab. 4). Posturogram variables generally decreased with age, but this decrease wasn't statistically significant (Tab. 4). The analysis of variance with the single classification for Perimeter ratio and Area ratio showed no significant effects (Tab. 4). Also the correlation analysis of posturogram variables with opened and closed eyes and age showed no significant associations (Tab. 4).

Table 4. The analysis of variance for repeated measures (Note 1)

Perimeter					
Independent variables	SS	DF	MS	F	p

Free term	22264980	1	22264980	308,81	0
Age groups	209145	2	104573	1,45	0,25
Error	1802446	25	72098		
OE-CE	557081	1	557081	31,0743	**0,000008**
OE-CE - Age groups	34777	2	17389	0,96	0,39
Error	448185	25	17927		

Ellipse Area

Independent variables	SS	DF DF	MS	F	p
Free term	21245034	1	21245034	52,54	0
Age groups	801211	2	400606	0,99	0,38
Error	10107697	25	404308		
OE-CE	1643698	1	1643698	5,30357	**0,029882**
OE-CE – Age groups	487872	2	243936	0,78	0,46
Error	7748081	25	309923		

Perimeter Ratio

SS	df	MS	SS	df	
Effect	Effect	Effect	Error	Error	Error
2693,45	2	1346,73	33174,7	25	1326,99

Area ratio

SS	df	MS	SS		df
Effect	Effect	Effect	Error	Error	Error
30297,01	2	15148,51	569407,7	25	22776,31

The analysis of correlation of posturogram variables with opened and closed eyes and age

Posturogram variables	Age (OE)	Age (CE
Perimeter	R=-0,29; p=0,13	R= -0,31; p=0,10
Ellipse Area	R=-0,32; p=0,087	R= -0,25; p= 0,18
Perimeter Ratio	R= -0,04; p=0,81	
Area ratio	R= -0,10; p=0,58	

Within the meaning of *etiopathogenesis*, scoliosis is only a symptom, an external expression of unrecognized pathology, which can occur in any segment of the spine and in *children* of *different ages.* In the present state of knowledge it is reasonable to talk more about the etiological factors, not about the theory (genetical, metabolic etc.) of scoliosis formation. Currently the concept which has got the most supporters is a multifactorial, including genetical (CHD7 gene) conditioned pathology of central nervous system, which causes changes in postural system (Tam et al. 2014). Scoliotic posture means a tendency to deflect the axis of the spine from a straight line, associated rather with the wrong habit of keeping the individual body segments. At the beginning each spontaneously growing scoliosis is a *gradual low curvature – scoliotic posture (Myers, 2016).* After time it reveals the actual development trends (Byun & Han, 2016; Kim & Hwang, 2016). In a *pathobiomechanical* term*, scoliosis* is compensated when the original deflection (a) goes smoothly into compensatory, proximal and distal deflection (Porte et al. 2016). Then the compensatory deflections are enough developed, and they equilibrate the original deflection. The sum of their angle values corresponds approximately to the angle value of original deflection. Scoliosis is the result of original imbalance of vertically poised spine. Posturogram variables are the elements of body balance (van Herwijnen et al. 2016). Overall assessment of efficiency of the balance system provides the posturography test. This is possible because of the reactions analysis and postural strategies, which forms the basis of mechanisms that promote the body in balance (Saifi, Kang & Lehman, 2016). Balance is a certain state of postural system, which is characterized by the vertical orientation of the body achieved due to aligning the forces acting on a body and their moments (Nikolova et al. 2015). The balance is provided by the nervous system through the reflex tension of respective muscle groups called anti-gravity muscles (Romano et al. 2008). Some informations about the body balance gives the analysis of individual posturogram variables. Scoliosis is a disease associated with disorders of the central stabilization of the body caused by postural hypotonia. Disorders of posturogram variables that occurs in scoliosis affects on pathoetiology of scoliosis and reversal movements of individual body segments *increase the amplitudes* of these variables. Stabilization disorders associated with dysfunction of CNS, and postural hypotonia seen in the increased posturogram variables, are probably primary and they precede scoliotic changes (Wilczyński et al., 2018).

4. Conclusions

The analysis of variance showed a significant effect of study options which clearly differentiates Perimeter and Ellipse Area in Romberg's Test. In a study with eyes closed a significant increase of these variables has been observed. Posturogram variables generally decreased with age, however, analysis of variance showed no statistically significant effects. The analysis of the Spearman rank correlation of posturogram variables with age of examined persons also showed no significant associations.

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Note

Note 1. In analysis of ariance the symbols mean: SS – sum of square, DF –degree of freedom, MS –mean of squares, F – ratio of MS effect to MS error, p – level of significance.

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Application Degree of High School Principals in Aqaba/Jordan to the Japanese KAIZEN Model to Reduce the Waste of School Time as Perceived by Teachers

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Abstract

The study aimed at identifying the application degree of high school principals in Aqaba/Jordan to the Japanese KAIZEN Model to reduce the waste of School time as perceived by teachers. The sample of the study consisted of (372) teachers, who were chosen using the stratified random technique, during the second semester of the academic year 2017/2018. A 36-item questionnaire; divided into three domains, was developed for data gathering. The findings of the study indicated that the degree of principals' use of the Kaizen model from the teachers' point of view was medium. The ranking of the three questionnaire domains was as follows: cooperation, continuous improvement of work, and decision-making. Furthermore, the results indicated that there are no statistically significant differences at the level (&=0.05) attributed to the study's three variables: gender, scientific qualification or years of experience.

Keywords: KAIZEN model, waste of school time, public secondary schools, teachers, Aqaba, Jordan

1. Introduction

The last few years witnessed huge leaps in the field of educational work development; a lot of points of views were changed concerning its management. The new attitudes are looking for the total quality approach and the importance of its educational organization performance in order to keep up with the requirements of our era. The school administration has been changing through time and new forms and names of management has been developed such a crisis management, knowledge management, strategic management, time management and other new forms and names that imposes themselves in modern administration.

For the purpose of excellence, the competition today is directed toward improvement, development renewal and creativity in all aspects of its organization activities in addition to the applicable methods and technologies as well as its outcomes weather in the form of goods or services. Quality becomes its distinguished element for excellence among organizations. Quality requires the collective efforts, capabilities and resources of organizations as well as reducing time wasting in all operations in order to achieve its objectives effectively and efficiently (Abu AL Naser,2015). Al- Sha'alan (2011) mentioned that all of the advanced countries have been using new methods in the field of total quality in their administration systems; where such new methods applying scientific and methodological steps to achieve their goals as well as improving their performance and increasing productivity in the most minimal time, efforts and coast. Japan has adopted an administration approach which develops and improves its organizations and that approach was Kaizen Model.

Accordingly, a lot of organizations turn to use different models by which they can specify points of strength and weakness in their performance and according to the evaluation results performance will be corrected accordingly as well as obtaining development and required improvement. In the educational organizations in general and schools in particular there is a need to use a lot of models and modern methods to use time effectively, and eliminate time wasting through exercising activities which do not participate in achieving the desired objectives; therefore, schools are required to look for specific procedures to exploit and improve time use in order to achieve objectives efficiently within specific time frame. One of these models is the Kaizen model for continuous improvement.

Time is considered as an important element in educational organizations, as one of the main inputs of the educational process. Time also is considered as one of the basic resources in schools since schools conduct different and overlapping operations such as planning, organizations, coordination and supervision as well as other operations. Time wasting and miss-use will be negatively reflected on schools in terms of achieving their objectives effectively and efficiently as well as non-improvement of performance and productivity. Since high schools are very much interested in the best use of recourses, and since time is a unique and valuable resource and input of high schools inputs and the school interest to use time effectively and to specify operations and fields which waste time in order to achieve its objectives and to improve its productivity and performance, it is deemed necessary that schools including high school should reconsider all administrative methods and strategies in order to achieve high level of productivity and performance which enable them to offer a total quality services. According to what has been mentioned earlier this study is designed to discover the extent of the application of Japanese Kaizen model by high school principals in Aqaba Governorate; Jordan, from the teachers' point of view.

1.1 Problem of Study

1   The success of any school depends on different resources where providing all required conditions for all employees by its principal in order to effectively achieve the school objectives taking in to consideration time use and application of modern concepts and methods. Time is a major part of any job or mission to be carried out; therefore, it should be used and managed properly. Time is the indicator by which the success of school principals and employees can be judged in terms of performing their administrative tasks. If school principals, teachers and administrative staff do not have the required skills,the time allocated for administrative responsibilities will be subject for loss and misuse and ultimately the required objectives of the school will not be achieved.

2   Through the experience of the two researchers on the issue of time management in high schools in Jordan, they have noticed that there were a lot of time wasting and procrastination of decisions which is negatively reflected on the achievement of the school objectives. Therefore, the researchers have conducted this study.

1.2 Objective and Questions of Study

The purpose of this study is to identify the application degree of the high school principals in the governorate of Aqaba / Jordan to the Japanese Kaizen model to reduce the waste of school time from the point of view of the teachers of those schools. To achieve this goal, the study attempted to answer the following two questions:

Question 1: What is the application degree of the high school principals in the governorate of Aqaba / Jordan to the Japanese Kaizen model to reduce the waste of school time as perceived by the teachers of those schools?

Question 2: Are there statistically significant differences between the means of the teachers' perceptions of the implementation of the secondary school principals in Aqaba / Jordan for the Kaizen model to reduce the waste of school time due to the variables: gender, scientific qualification and years of experience?

1.3 Importance of the Study

The importance of this study comes from the importance of its subject; which is time management, and more specifically the importance of this study is determined by the following:

- The results of this study are expected to benefit school principals, teachers and administrative staff, with regard to reducing waste of time.
- It is hoped that the Kaizen model will become an entry point for efficiency and productivity, by reducing waste of school time.
- Finally, it is hoped that this study will benefit researchers and interested people by providing a theoretical framework for the Kaizen model of reducing waste of time, as well as providing a tool to measure the wasting of school time.

1.4 Definitions

The present study includes a number of terminologies which are defined as follows:

- **Time wasting**: Loss of time without doing any job or mission or carrying out activities efficiently, and thus not achieving the desired targets on time (Al-Alaq, 2016). Time wasting is defined operationally as the failure to perform the tasks and duties required, or to carry out unplanned activities and tasks, without obtaining value or interest, and not completing tasks on time. It is measured through the questionnaire developed by the researchers for this purpose.

- **Kaizen-Model**: it is a methodology or strategy that applies a continual and gradual improvement which may be small in size but has a great impact and it participates in increasing productivity, reducing operational costs, minimizing all types of waste. It participates in increasing and improving innovation and creativity of employees and it improves and develops operations and activities in the organization through minimizing time wasting (Abu Al-Nasr, 2015).

1.5 Limitations of the Study

This study was limited to teachers (male and female), who are working in public high schools in Aqaba Governorate/ Jordan, during the second semester of the school year 2017/2018.

2. Reviewing the Relevant Theoretical Literature

2.1 Kaizen Concept

The Kaizen concept emerged in 1984 by the Japanese expert Masaki Imai who published a book titled (Kaizen philosophy) in 1986. In 1997, he published another book titled (Low Approach to Management and Common Sense:(Kaizen Gemba). Kaizen is a philosophy created by Tatichi Ohno for leading organizations through good governance of place and time (Abu Al-Nasr, 2015).

The Kaizen term consists of two Japanese words (Kai)that means (change), and the word (Zen)which means (to the best). Thus, the overall meaning of the term Kaizen becomes: continuous improvement. The Kaizen is considered one of the most important and up to date methods in terms of cost reduction and quality improvement since it follows a distinguished methodology in application. It applies improvements gradually and continually on services and products where such improvements lead to cost reduction and elevation of quality level of services and products in continuous way.

The Kaizen philosophy is based on the possibility of improving any work being executed and that every process must have a sort of waste; minimizing or removing such waste will result in an added value for the process as well as for the costumer. Therefore, combating waste in the first priority of the Kaizen application and it is considered as one of its basis (Abu Al-Nasr, 2015). Each activity and process has two parts one of them is useful and enriches the work and adds a high value and the other part is useless and does not add any value or enrich the work ultimately the first part produces a tangible and useful work and its cost is invested, whereas the second part produces waste in time, effort and money (Abu Al-Ragheb and Sahwish, 2016).

2.2 Change Theory by USING Kaizen

The Kaizen believes in creating change in an unsurprising, continuous, gradual and partial way taking in to consideration its smallest level provided that all employees should be involved. Change by using Kaizen emphasizes two types of results (Qassem, 2014):

a. First type: social results which guarantee the change in the culture of the organization and the employees through learning and considering learning activities as a basic element of Kaizen philosophy where each person learns to identify his objectives and achieving such objectives.

b. Second type: eliminating waste or loss in operations as much as possible which finally leads to improve the time of the process, cost and quality and this is the technical part of the process.

Abdel-Qader (2008) summarizes the Kaizen as follow: it works on continuous improvements in all sides and all times and there are a lot of elements which are emphasized in accordance with this process such as focus on customer, relationship between management and staff, spirit of cooperation, team work, production on specific time, quality circles and finally use of technology in work. All of these elements work together within Kaizen concept in organizations applying this methodology.

The Kaizen is considered as a quick improvement process run by work groups of managers and staff as one team in order to achieve the predefined objectives. The improvements process may follow the following steps: defining the problem, selecting best employees, problem solving or corrections of malfunctions within a week or less by using Kaizen technology tools. The final goal is cost reduction, minimizing time waste, eliminating loss and emphasizing continual improvement (Abu Al-Ragheb and Shahwish, 2016).

2.3 Kaizen Principles

Shaalan (2011) indicated that the Kaizen model is based on six main principles, which will lead to higher quality and lower cost. These six principles are

1. Continuous improvement is the responsibility of each person in the educational organization and not according to each group or specific administrative level.

2.   Continuous improvement of processes achieves high quality results.

3.   Focusing on performance improvement in all aspects since improvement is not limited to one field; however, it includes all fields in the educational organization: productivity, financial, administrative … etc.

4.   Development and improvement will not be accomplished without admitting the presence of problems.

5.   The administration has two tasks: quality of planning and quality of application, where these two processes became parallel and the responsibility of all levels in the organization. The highest administrative levels are in charge of planning quality; however, the quality of application is the responsibility of those in charge of implementation.

6.   The Kaizen concept is an integrated blend of administrative thought, labor system, problems analysis and decision making.

3. Previous Relevant Studies

This section deals with previous studies related to the two subjects of the study: Kaizen model and time wasting. These studies have been arranged chronologically from oldest to newest, as follows:

3.1 Studies Related to Kaizen Model

Al-Smadi (2001) has conducted a study entitled, "Employees attitudes toward application of Japanese Kaizen model to improve work and facing modern competitiveness in the third millennium: Jordanian Industrial Private Sector'. A random sample of (870) employee in (30) industrial organizations randomly distributed on the industrial cities in the three largest Jordanian cities (Amman, Irbid, Zarka). Results of the study indicated that small size organizations were more tending to benefit from the innovative capabilities of the employees more than the large size organizations. The study also indicated that employees with decision making regarding their work as well as their suggestions to improve the work were less than the required level in relation to Japanese Kaizen model. The study concluded that the administration point of view regarding continual improvement concept is far away from Kaizen concept.

Jawad (2005) has conducted a study entitled, "Comparative study for continual improvement Inputs". The study aimed to explain and discuss the theoretical basis for each of: Lean, Kaizen, Total quality management, Capability maturing model, ISO, Six Sigma and Manufacturing as the important inputs of continual improvement. This study dealt with the focus philosophy on continual improvement in Japanese Kaizen method and to compare the inputs in accordance with different standards as well as to present a theoretical frame work which helps the organizations to select the appropriate input which is the most suitable for its problem and culture and to remove the vagueness which surrounds the selection of the most suitable input of continual improvement inputs. The study proved that the continual improvement does not apply only on the quality of the product but also applies on the processes improvement. The continual improvement implies identifying of comparison basis for best practices and the creation of a sense among the employees that they own the whole processes.

Oaki (2008) conducted a study entitled, "Transferring Japanese Kaizen Activities to overseas in China". Three organizational capabilities were defined by the researcher as follow capabilities which help in increasing the employees' self-initiative, capabilities which help facilitation of overlapping occupational communication and the capabilities which develop the employee discipline. The study covered nine Japanese factories (medium, large size) in china. The results indicated that the successful cases have common characteristics for the administration practices such as encouraging the team proposals system rather than the individual proposals system and personal management focuses on having multi-mission employees as well as long term employment and also characterized by the daily visits of the manager to the work sites.

Magnier-Watanble (2011) conducted a study entitled, "Getting ready for Kaizen: organizational and knowledge management enablers". The researcher used the case study model where she applied the study on (Nummi) organization for vehicles manufacturing in the state of California. The study concluded that there are a number of factors that help in the success of Kaizen practical application. From the organizational factors the researcher found that the horizontal organizational structure and the unofficial relationships within the organization which based on innovation strategy are the best factors that lead to the success of the Kaizen. However, for the knowledge management factors the researcher found that: focus on acquiring knowledge from inside the organization where interaction between the employees create experiences and knowledge, as well as strong knowledge through sharing it with the team and granting the individuals to use such knowledge and to explore more of it were found to be the best cofactors that help in the success of the Kaizen. The Kaizen process is successful in the organization of high degree of independency, self-discipline, openness and where

organizational characteristics go side by side with the knowledge management practices within the organization.

Al-Kaser (2014) conducted a study entitled, "Kaizen Strategy Application Requirements in Management for the Purpose of Improving Administration processes as Perceived by Administrative Board (A field Study on Girls' Faculty of Education-at Shagra'a). The results indicated that Kaizen strategy requirements for administration obtained a high evaluation and the possibility of the strategy application requirements obtained a medium evaluation.

3.2 Studies Related to Time Wasting

Taylor (2007) conducted a study entitled, "A study of principals' perception regarding time management". A sample of high school principals in Nevada Statewere selected. The study has achieved the following results: The principals of schools with (1001) student and more spend more time in time management more than principals of schools of less than (1000) student. Female principals spend more time in educational management than male principals. The study showed that (43%) of high school principals are in need for a critical focus and direction of their educational management in order to improve their leadership levels. Principals also, through the study, identified the areas of time wasting which will enable them to have the proper recommendationsto use their times effectively.

Al-Yahyawi (2012) conducted a study entitled, "Time Management by Middle Schools Female Principals at Al-Madinah Al-Monwarah". The sample consisted of (20) female principals. The study results indicated that the top missions that take more time are the administrative missions followed by technical missions, personal missions and then missions related to local community. The results clarified that there are some factors lead to waste the time of the female principals, such as reviewing and answering coming mail, daily routine, lots of notices, and absence of principals. The results also indicated that the most efficient method for time saving is using the computer in work organization and providing a comfortable work atmosphere.

Al-Qahtani (2013) conducted a study entitled, "Degree of Procrastination and Time use Efficiency and Occupational Performance and the Relation between them among Public High Schools Principals in Kuwait". The study sample consisted of (200) school principals, half of them males and the other half females. The results indicated a tendency for procrastination and the effective use of time by principals is not high, in addition to that tendency for procrastination by principals has a clear impact on the principal visualized occupational performance through the intermediate effect for time efficiency usage. The total impact was clear and effective.

Grissom, Loeb& Mitanni (2015) conducted a study entitled, "Principal Time Management Skills: Explaining Patterns in Principals Time Use, Job stress, and Perceived Effectiveness". Time management skills scale was used on a sample size of (287) principal in Miami Deed County. The study results indicated that the performance of the principals is improved as much as they know the principles of time management and when they have an allocated time to manage the schools and it is also indicated that a lot of time can be saved by the principals when applying time management strategies. It is also indicated in the results that the perfect time management is the translation of the principal performance in to questions in need for answers about the best way to perform a mission.

3.3 What Distinguishes this Study from Previous Studies

The previous studies related to Kaizen model were few and most of them were applied on industrial organizations and not on educational institutions except Al-Kaser (2015) which was applied at the Girls' Faculty of Education-Shagra'a University. The previous studies did not discuss the Kaizen with time wasting, however it emphasized the importance of the Kaizen model since it leads to improve the efficiency, quality and cost reduction and that there are other factors that support the application of Kaizen model such as higher administration support and organizational factors and that is clear in (Magnier-Watanbe, 2011). It is also clear, from the review of the previous studies, the importance of time since it is an important indicator in the efficiency of school management.

This study is distinguished by presenting and analyzing the previous attempts in the areas of research concerning time management and time wasting, Kaizen model, development of a questionnaire to discover how far the public high schools' principals in Aqaba Governorate -Jordan, apply the Japanese Kaizen model to minimize time wasting from teachers' point of view. This study will participate in enriching the applicable and scientific sides since it deals with an important issue which is minimizing time wasting by using Kaizen model. It is also distinguished from previous studies because it is from the early studies discussing the relation between time and Kaizen model and this was not discussed in the previous studies and to the best knowledge of the researchers

4. Methodology

This study followed the descriptive survey approach as the most appropriate for this type of studies.

4.1 Population of the Study

The population of this study consist of all (573) male and female teachers of the public high schools in Aqaba Governorate; Jordan, who have been working during the second semester for the academic year 2017-2018 (Directorate of Education in the Governorate of Aqaba, 2017-2018).

4.2 Sample of the Study

Using the stratified random technique, the study sample consisted of (372) teachers; Distributed according to gender variable as follows: 115 males and (257) females, of public secondary schools, from those who are working during the second semester of the academic year 2017-2018, at Aqaba Education Directorate, as shown in the following table.

Table 1. Distribution of the study sample by Sex, Qualifications and Experience

Variable	Category	Quantity	Total
Sex	Male	115	372
	Female	257	
Educational Qualifications	B.A	253	
	B.A & Diploma	98	372
	Master & PHD	21	
Years	5 years or less	48	
Of	6 - 10 years	125	
Experience	11 – 15 years	95	372
	16 years or more	101	

4.3 Study Instrument

To achieve the study objectives, a 36-item questionnaire was developed, based upon the theoretical literature and related previous studies, namely: Kariuki (2013) and Al-Smadi (2001). The questionnaire was divided into three domains: Decision making (9 paragraphs), Participation (10 paragraphs) and Continual improvement (17 paragraphs). To answer the items of the questionnaires, the 5-choice Likert scale was used: Very high, high, medium, low and very low.

4.4 Questionnaire Validity

To verify the validity of the study instrument, the two researchers presented the questionnaire to (11) arbitrators of university professors and experts in the field of educational administration, foundations, measurement and evaluation in the University of Jordan and the University of Mutah, to ensure the validity in terms of construction, language integrity and clarity. The remarks of all arbitrators were taken into consideration.

4.5 Questionnaire Reliability

To verify the reliability ofthe questionnaire, the Cronbach-alpha coefficient was calculated for its domains as shown in the following table.

Table 2. Cronbach-Alpha Correlation Coefficient for the Instrument

No.	Domain	Cronbach-Alpha Coefficient
1	Decision making	0.77
2	Cooperation	0.73
3	Work improvement	0.94

4.6 Study Variables

The study included three types of variables as follows:

a. **Independent Variable**: The perceptions of high school teachers in the governorate of Aqaba / Jordan to the extent of the application of their school principals to the Kaizen model to reduce the waste of school time.

b. **Secondary Independent Variables**: The study includes three independent intermediate variables:

- Gender: (Male, Female).

- Scientific Qualification:(B.A, B.A& Diploma, M.A. & PhD).

- Years of Experience: (5 years or less, 6-10 years, 11-15 years, 16 years or more).

c. **Dependent Variable**: The application degree of the high school principals in the governorate of Aqaba / Jordan to the Japanese Kaizen model to reduce the waste of school time.

4.7 Statistical Processing Methods

To meet the study objectives, the Statistical Packages for Social Sciences (SPSS) program was used to analyze data and obtain the results as follows: Frequency and percentages to describe the characteristics of study sample, means and standard deviations to identify responses of sample members on the questionnaire, Pearson Correlation and One-way ANOVA for finding out correlation between variables, and Cronbach's Alpha to verify the reliability of the questionnaire.

In order to identify the application degree of the high school principals in the governorate of Aqaba / Jordan to the Japanese Kaizen model to reduce the waste of school time, the following equation was used: The highest choice of answer (5), minus the minimum choice of answer (1), divided by the number of options (3). This means: 5-1=4/3=1.33. Accordingly, the values of the three levels are as follows: Low level (means2.33 or less), medium level (2.34-3.67), and high level (3.68 or above).

5. Study Results

In this section, the two researchers present the study results in accordance with its questions as follows:

5.1 Results Related to Question

(1): What is the application degree of the high school principals in the governorate of Aqaba/ Jordan to the Kaizen model to reduce the waste of school time as perceived by the teachers of those schools?

To answer this question, means and standard deviations for each domain of the questionnaire were calculated as clarified in table (3) below:

Table 3. Means, standard deviations and rank for the sample on the domains of the questionnaire of Kaizen model for minimizing time wasting at schools and the degree of its application by public school principals

No.	Domain	Means	Standard deviations	Rank	Application Degree
2	Participation	3.63	0.87	1	Medium
3	Work improvement	3.25	0.67	2	Medium
1	Decision making	3.00	1.03	3	Medium
	Total	**3.29**	**0.76**		**Medium**

The results indicated that the degree of application of Kaizen model for minimizing time wasting by public high schools' principals in Aqaba Governorate/ Jordan as perceived by teachers was medium, where the mean was (3.29) with a standard deviation of (0.76). All domainsof the questionnaire were medium, where the means ranging between (3.00 – 3.63). The participation domain was in the first rank with a mean of (3.63) and standard deviation of (0.87), followed by work improvement with a mean of (3.25), and finally the domain of decision making with a mean of (3.00) and standard deviation of (1.03).

In addition, the two researchers calculated the means and the standard deviations of the responses of the study sample members on the items of each domain, as follows:

5.1.1 First Domain: Decision Making

The two researchers calculated the means and the standard deviations of the degree of application of the secondary school principals in Aqaba Governorate in Jordan to the Japanese Kaizen model to reduce the waste of school time from the teachers' point of view to the decision-making domain, as shown in table (4):

Table 4. Means, standard deviations and rank of the degree of application of the secondary school principals in Aqaba Governorate in Jordan to the Japanese Kaizen model to reduce the waste of school time from the teachers' point of view to the items of decision-making domain

NO.	Items of Decision Making Domain	Mean	S.D	Rank	Degree of Application
9	The administration delegates me by authorities which enable me to do my job.	3.53	1.06	1	Medium
5	My participation in decision making gains importance.	3.38	1.11	2	Medium
1	I seek the administration help in any decision I want to make.	3.30	1.22	3	Medium
6	My participation is important and my thoughts and points of views were taken in to consideration when making decision.	3.23	1.09	4	Medium
2	I sometimes took the initiative without referring to my boss.	3.07	1.06	5	Medium
3	School is a good place to make my own decisions.	2.98	1.20	6	Medium
7	The administration rewards me when participating in decision making.	2.80	1.12	7	Medium
4	I refer frequently to the administration even in minor issues related to my job.	2.55	1.24	8	Medium
8	The administration asked me to participate obligatory in decision making.	2.20	1.08	9	Low
Total		3.00	1.03		Medium

5.1.2 Second Domain: Participation

The two researchers calculated the means and the standard deviations of the degree of application of the secondary school principals in Aqaba Governorate in Jordan to the Japanese Kaizen model to reduce the waste of school time from the teachers' point of view to the participation domain, as shown in table (5):

Table 5. Means, standard deviations and rank of the degree of application of the secondary school principals in Aqaba Governorate in Jordan to the Japanese Kaizen model to reduce the waste of school time from the teachers' point of view to the items of participation domain

NO.	Items of Participation Domain	Mean	S.D	Rank	Degree of Application
12	Participation relationships lead to a better performance at school	4.15	0.88	1	High
19	Our managers encourage contact between teachers to develop the school performance	4.01	0.95	2	High
13	The school works as a partner with the local community	3.95	0.97	3	High
10	The administration encourages everyone to work together to achieve the joint objective	3.88	1.01	4	High
11	The administration works to encourage the participative relationships between teachers	3.81	1.05	5	High
14	The administration encourages the constructive competition between teachers to improve their performance	3.57	1.07	6	Medium
18	Most problems at school created by people who don't do extra efforts	3.44	1.02	7	Medium
17	Most of the problem resulted due to lack of motivation	3.16	1.14	8	Medium
15	Most of the problems in the school resulted from the processes and not individual	3.17	0.99	9	Medium
16	Most of the mistakes committed by individuals working at schools	3.03	0.97	10	Medium
Total		3.63	0.87		Medium

5.1.3 Third Domain: Work Improvement

The two researchers calculated the means and the standard deviations of the degree of application of the

secondary school principals in Aqaba Governorate in Jordan to the Japanese Kaizen model to reduce the waste of school time from the teachers' point of view to the work improvement domain, as shown in table (6):

Table 6. Means, standard deviations and rank of the degree of application of the secondary school principals in Aqaba Governorate in Jordan to the Japanese Kaizen model to reduce the waste of school time from the teachers' point of view to the items of work improvement domain

NO.	Items of Participation Domain	Mean	S.D	Rank	Degree of Application
33	The administration considers work improvement as a part of work performance	3.70	1.97	1	High
32	The administration is always interested in work improvement	3.67	1.07	2	Medium
25	The administration encourages new proposals to improve performance at the school.	3.62	1.05	3	Medium
24	New development proposals are seriously taken by the administration.	3.56	1.06	4	Medium
20	The school forms work teams to solve the problems	3.44	1.12	5	Medium
22	The administration encourages the work teams to solve the problems.	3.42	1.10	6	Medium
26	The administration adopts most of the proposals submitted by teachers.	3.38	0.99	7	Medium
23	The administration benefits from work teams point of views before decision making.	3.38	1.07	7	Medium
21	The administration encourages the work teams to improve performance at schools.	3.34	1.09	9	Medium
28	The administration asks me to present proposals for work improvement.	3.36	1.13	8	Medium
27	The administration inform the teachers if they applied their proposals.	3.26	1.09	10	Medium
34	The administration rewards me for submitting proposals to improve the work.	3.16	1.16	11	Medium
29	The administration carefully studies my proposals to benefit from them.	3.14	1.10	12	Medium
30	The administration rewards me when I have new achievement at work.	3.00	1.17	13	Medium
36	The administration always conduct training courses to enhance the teachers skills in order to improve the work.	2.93	1.19	14	Medium
35	The administration held me accountable when I don't achieve any improvement at work.	2.65	1.17	15	Medium
31	The administration forces me to present proposals.	2.28	1.12	16	Low
Total		**3.25**	**0.67**	**Medium**	

5.2 Results related to question (2): Are there statistically significant differences between the means of the teachers' perceptions of the implementation of the secondary school principals in Aqaba / Jordan for the Kaizen model to reduce the waste of school time due to the variables: gender, scientific qualification and years of experience?

To answer this question, the required statistical processes were conducted for each variable separately and as follow:

5.2.1 Sex Variable

To determine if there were statistically significant differences at the level of (α = 05) between male teachers and female teachers' views on the degree of application of secondary school principals in Aqaba Governorate in Jordan to the Kaizen model,means and standard deviations of response scores were calculated according to the gender variable (males, females).In addition, (t-test) was used to examine the differences in the response of the participants to the study's questionnaire three domains, as shown in table (7):

Table 7. t-test results between responses average of the study sample el for minimizing time wasting in Aqaba public high schools in Jordan.

Domain (Variance)	Sex	No. of Participants	Mean	S.D	t-test value	Degrees of freedom	Sig.
Decision making	M	115	3.04	0.62	0.67	370	0.50
	F	257	2.99	0.36			
Participation	M	115	3.54	0.57	2.12	370	0.03
	F	257	3.67	0.32			
Work improvement	M	115	2.06	1.39	2.16	370	0.03
	F	257	3.31	0.77			
Total	**M**	**115**	**3.22**	**0.24**	**1.68**	**370**	**0.09**
	F	**257**	**3.33**	**0.25**			

The results indicated that there are no differences with statistical significances (α=0.05) between the means of the study sample responses on the degree of the application of Kaizen model for minimizing time wasting by public high school principals in Aqaba Governorate - Jordan as perceived by teachers in terms of (decision making) and the instrument as a whole. In terms of (participation) domain, there are differences where t-test value was (2.12) with a significance level of (0.03) and this is a value with a statistical significance and it is in favor of the highest average, that is the female.

Finally, the results indicated that there were statistically significant differences in the third domain; improvement in work, where the value of t-test (2.16) with a significance level (0.03). This value is statistically significant, in favor of the upper average, that is the females.

5.2.2 Scientific Qualification Variable

To determine if there were statistically significant differences at the level of (α = 05) between teachers' views on the degree of application of secondary school principals in Aqaba Governorate in Jordan to the Kaizen model, means and standard deviations of response scores were calculated according to the scientific qualifications variable, as shown in table (8):

Table 8. Means and Standard Deviations of Teachers' Responses on the Reality of the Use of Secondary School Principals in the Governorate of Aqaba / Jordan for the Kaizen Model to Reduce the Waste of School Time According to the Scientific Qualifications

Domain	Scientific Qualifications	Number of participants	Mean	Standard Deviation
Decision making	B.A	253	2.97	0.58
	B.A & Diploma	98	3.18	0.63
	M.A or PHD	21	2.89	0.66
Participation	B.A	253	3.62	0.53
	B.A & Diploma	98	3.67	0.57
	M.A or PHD	21	3.54	0.63
Work improvement	B.A	253	3.25	1.31
	B.A & Diploma	98	3.22	1.30
	M.A or PHD	21	2.99	1.49
Total	B.A	253	3.88	2.07
	B.A & Diploma	98	3.37	2.22
	MA or PHD	21	3.12	0.25

It is clear from Table (8) that there are apparent differences between the means of responses of the study sample members for each domain of study's instrument according to the variable of the scientific qualification. In order to identify whether these differences have a statistical significance on significance level (α=0.05),the one-way ANOVA analysis was used and the results indicated that there are no differences with statistical significance on level (α=0.05) between the means of the study sample individuals responses concerning the use of Kaizen model

for minimizing time wasting in public high schools in Aqaba Governorate – Jordan on each domain of the questionnaire and of the tool as a whole which may be referred to the scientific qualification level,   as clarified in table (9).

Table 9. Results of the One-way ANOVA test for the responses of the study sample members of the questionnaire domains according to the variable of the scientific qualification

Domain	Section	Total of Squares	Degrees of freedom	Squares average	F-test value	Sig.
Decision making	Between groups	16.50	2	8.25	2.30	0.0
	Within groups	132.69	369	0.36		
	Total	134.34	371			
Participation	Between groups	3.70	2	1.85	0.63	0.54
	Within groups	110.47	369	0.30		
	Total	110.85	371			
Work improvement	Between groups	56.40	2	28.20	1.62	0.20
	Within groups	642.10	369	1.47		
	Total	647.74	371			
Total	Between groups	16.74	2	8.24	0.17	1.80
	Within groups	168.92	369	0.46		
	Total	170.57	371			

5.2.3 Years of Experience Variable

To determine if there were statistically significant differences at the level of ($\alpha = 05$) between teachers' views on the degree of application of secondary school principals in Aqaba Governorate in Jordan to the Kaizen model, means and standard deviations of response scores were calculated according to the years of experience variable, as shown in table (10):

Table 10. Means and Standard Deviations of Teachers' Responses on the Reality of the Use of Secondary School Principals in the Governorate of Aqaba / Jordan for the Kaizen Model to Reduce the Waste of School Time According to the Years of Experience

Domain	Years of experience	Number of participants	Mean	S.D
Decision Making	5 Years or Less	48	3.07	0.58
	6-10 Years	125	3.00	0.62
	11-15 Years	98	3.00	0.68
	16 Years or More	101	2.97	0.50
Participation	5 Years or Less	84	3.63	0.59
	6-10 Years	125	3.54	0.56
	11-15 Years	98	3.71	0.57
	16 Years or More	101	3.65	0.46
Work Improvement	5 Years or Less	48	5.63	1.18
	6-10 Years	125	5.38	1.33
	11-15 Years	98	5.68	1.44
	16 Years or More	101	5.50	1.24
Total	**5 Years or Less**	**48**	**1.20**	**1.78**
	6-10 Years	**125**	**1.16**	**2.21**
	11-15 Years	**98**	**1.10**	**2.39**
	16 Years or More	**101**	**1.18**	**2.00**

It is clear from Table (10) that there are apparent differences between the means of responses of the study sample

members for each domain of study's instrument according to the years of experience. In order to identify whether these differences have a statistical significance on significance level (α=0.05), the one-way ANOVA analysis was used and the results indicated that there are no differences with statistical significance on level (α=0.05) between the means of the study sample individuals responses concerning the use of Kaizen model for minimizing time wasting in public high schools in Aqaba Governorate – Jordan on each domain of the questionnaire and of the tool as a whole which may be referred to the years of experience,   as clarified in table (11):

Table 11. Results of the One-way ANOVA test for the responses of the study sample members of the questionnaire domains according to the variable of the years of experience

Domain	Section	Total of squares	Degrees of freedom	Squares average	F-test value	Sig
Decision making	Between groups	2.48	3	0.95	0.23	0.88
	Within groups	134.09	368	0.36		
	Total	134.34	371			
Participation	Between groups	18.08	3	6.02	2.03	0.11
	Within groups	109.04	368	0.30		
	Total	110.85	371			
Work improvement	Between groups	56.40	3	18.0	1.08	0.35
	Within groups	642.10	368	1.74		
	Total	647.74	371			
Total	**Between groups**	**14.29**	**3**	**4.76**	**1.07**	**0.38**
	Within groups	**169.14**	**368**	**0.46**		
	Total	**170.57**	**371**			

The results indicated that there are no differences with statistical significance (α=0.05) between the means of the study sample responses concerning the use of Kaizen model for waste of school time at public high schools in Aqaba-Jordan on all domains of the study and on the questionnaire as a whole which may refer to the variable of years of experience.

6. Discussion of Results

Below is a discussion of the study results according to its questions:

6.1 Discussion of results related to the first question: What is the application degree of the high school principals in the governorate of Aqaba / Jordan to the Japanese Kaizen model to reduce the waste of school time as perceived by the teachers of those schools?

The results of the study showed that the degree of estimation of the members of the study sample on all domains of the instrument was medium. This is an indicator that the principals of secondary schools in the governorate of Aqaba / Jordan do not perform their roles associated with reducing the waste of school time according to the Kaizen model.

This result is not consistent with Kaasen's principles, which emphasize the participation of employees in decision making process, because they are familiar with their work procedures, and have the ability to improve work to reduce the time of their tasks and improve performance and save time.

6.2 Discussion of results related to the second question: Are there statistically significant differences between the means of the teachers' perceptions of the implementation of the secondary school principals in Aqaba / Jordan for the Kaizen model to reduce the waste of school time due to the variables: gender, scientific qualification and years of experience?

The study results indicated that there are no statistical significance differences on the significance level (&=0.05) for the whole tool in relation to the study samples points of views regarding the application of Kaizen model for reducing time waste which may refer to gender variable and that could be resulted from the understanding of

most of the teachers to the basis of Kaizen model. The results also indicated that there are no statistical significance differences on the significance level of (α=0.05) which may referto decision making and the presence of differences in the domains of participation and work improvement in favor of female teachers and this is resulted from the interest of females in professional developments through training courses which is ultimately leads to improvement of work. The female schools are characterized by cooperation and participation of all and this might refer to the school administration. The study sample participants agree on the area of decision making which is a positive indicator, since decision making is considered an important process in schools' administrations.

The study results indicated that there are no statistical significance differences on the significance level on the questionnaire as a whole from the point of views of the study sample participants in relation to the use of Kaizen model for reducing time wasting which is may referred to scientific qualification and experience and this is my resulted from the understanding of Kaizen model basis by teachers regardless of educational level and experience.

In general, the results of this study are in consistent with Al-Qahtani (2013) study which indicated that schools' principals' efficiency in using time is not high and also with Al-Smadi (2001) study in the area of decision making which indicated that participation of employees in decision making is less than the required level.

7. Recommendations

Based on the findings of this study, the researchers recommend the followings:

1) Adoption of Kaizen model for reducing time wasting in high schools through the orientation of the employees about its importance and its application at schools.

2) Changing the prevailing organizational culture in schools to fit with the Kaizen model.

3) Conducting training courses for all employees at schools concerning the Kaizen model in order to facilitate its application at schools.

4) Conducting training courses for school principals and teachers to improve time management and use in perfect way.

5) Calling the concerned parties in the educational administration to encourage and motivate the researchers to conduct more studies in the field of time management.

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Comparison on Turn Costs in Accessibility Models. Case Study: Manizales, Colombia

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Abstract

The transport models have taken great relevance in the last decades because they help to make big urban planning decisions. In this sense, supply models, such as global average accessibility, seek to approach more and more to reality in order to represent it in the best possible way. In this research article, we compare the different penalties for turns used in the global average accessibility models in the city of Manizales, being compared with the preliminary results of a research thesis in which the penalties for turns were calculated by means of an empirical methodology that analyzes different road intersections in the city. At the end, the savings gradient method is used to measure the differences between the different calculated scenarios.

Keywords: global average accessibility, turn costs, saving gradient, case study

1. Introduction

Over the years, transport planners have created tools that allow a more efficient projection of this important section in the conception of the city; therefore, transportation models have become an indispensable tool given the investment in time and budget related to the different policies associated with them, such as the construction of new road infrastructure projects and the implementation of new public transport systems such as metro lines, aerial tramways or BRT (An, Teng, & Meng, 2008; Escobar & Garcia, 2011). Also, given the new perception of transport, which seeks for more efficient solutions to urban and regional mobility problems, it is imperative for the models to become closer to reality, in order to make better decisions that result in a future benefit for the majority of the population (Marvin & Guy, 1999, Owens, 1995). Transport models can be divided into two large groups: demand and supply models. Demand models seek to represent and predict what the inhabitants of a city require in terms of transport, while the models of supply, as the name implies, measure the transport supply found in a city or region (Ortúzar & Willumsen, 1994). According to Ortúzar and Willumsen (1994), the work of transportation modelers is to represent reality in the most accurate possible way, taking into account different factors such as average speeds of the road network, delays due to traffic jams and even turn costs of the different vehicles, for this reason, in this research article, the calculated turn costs gotten in an empirical way in the city of Manizales are used to measure the global average accessibility, as a transportation supply model. In addition, a comparison is made with respect to the turn costs used in previous investigations, which had been determined subjectively for the 2011 Mobility Plan (Escobar & Garcia, 2012).

The turn costs have been used since 2011 in the city of Manizales for the calculation of accessibility models, determined subjectively in 1 minute (60 seconds) for the right turn and 1.15 minutes (69 seconds) for the left turn. These penalties complement the Dijstkra (1959) algorithm of minimum paths. This is frequently used by various geographic information systems (GIS) programs to calculate the minimum route between different nodes in a

transport network and even the travel matrix, where multiple routes are taken into account (Coldwell, 1961; Winter, 2002; Zuluaga & Escobar, 2017). Likewise, this algorithm has been constantly improved by various researchers, making its application more efficient and accurate, mainly in large networks (Delling, Sanders, Schultes, & Wagner, 2009, Sanders & Schultes, 2005, Wu, Qin, & Li, 2015). On the other hand, accessibility models have been used since the 1920s as a transportation planning method in the United States (Batty, 2009, Mitchell & Rapkin, 1954). However, it was not until Hansen (1959) that the term accessibility was defined in a more specific way as "... the potential of interaction opportunities...", this was investigating the job opportunities located in the metropolitan area of Washington D.C. Later, various investigations on this subject have resulted in multiple approaches and methodologies for its measurement (Ingram, 1971, Pirie, 1979). In addition, Geurs and Ritsema van eck (2001) defined the different approaches and perspectives that this concept had, taking it to a new level in transport modeling. In addition, the different challenges and opportunities generated by the use of this model of supply to transport planners have been explored (Boisjoly & El-Geneidy, 2017; Geurs & Östh, 2016), reaching advances in various topics such as: equity in the transport (Guzman & Oviedo, 2018), accessibility to equipment such as hospitals (Cirino, Gonçalves, Gonçalves, & Souza De Cursi, 2018), parks (Wang, Brown, & Mateo-Babiano, 2013) and public bookstores (Park, 2012) , public transport (Curtis & Scheurer, 2015), among others. On the other hand, in the city of Manizales, accessibility measures have been frequently used for various urban planning issues, like to measure the impact of new road infrastructure projects (Moncada, Cardona, & Escobar, 2018; Perilla, Escobar, & Cardona, 2018), access to ambulance centers (Escobar, Holguín, & Zuluaga, 2016), public bicycle stations (Cardona, Zuluaga, & Escobar, 2017) and shopping centers (Zuluaga & Escobar, 2017), among others.

Manizales, capital of the department of Caldas in Colombia (see Figure 1), is located in the center west of Colombia on the central mountain range at approximately 2 150 meters above sea level over steep land reaching 5 863 hectares, which hinders the process of expansion and construction of new civil projects (Robledo, 1996). Likewise, regarding demography, according to population projections of the National Administrative Department of Statistics DANE, on 2017 the city will have a population of 371 307 inhabitants in its urban area, reaching Villamaría with 419 943 inhabitants, which is the closest border municipality. On the other hand, in terms of mobility data, 51% of trips are made by public transport, while private transport (motorcycles and vehicles) accounts for 29% of the modal share. As for the trips made in non-motorized transport, walking reaches 14%, on the other hand the bicycle gets a percentage of 1% (DANE, 2010; Manizales Como Vamos, 2017).
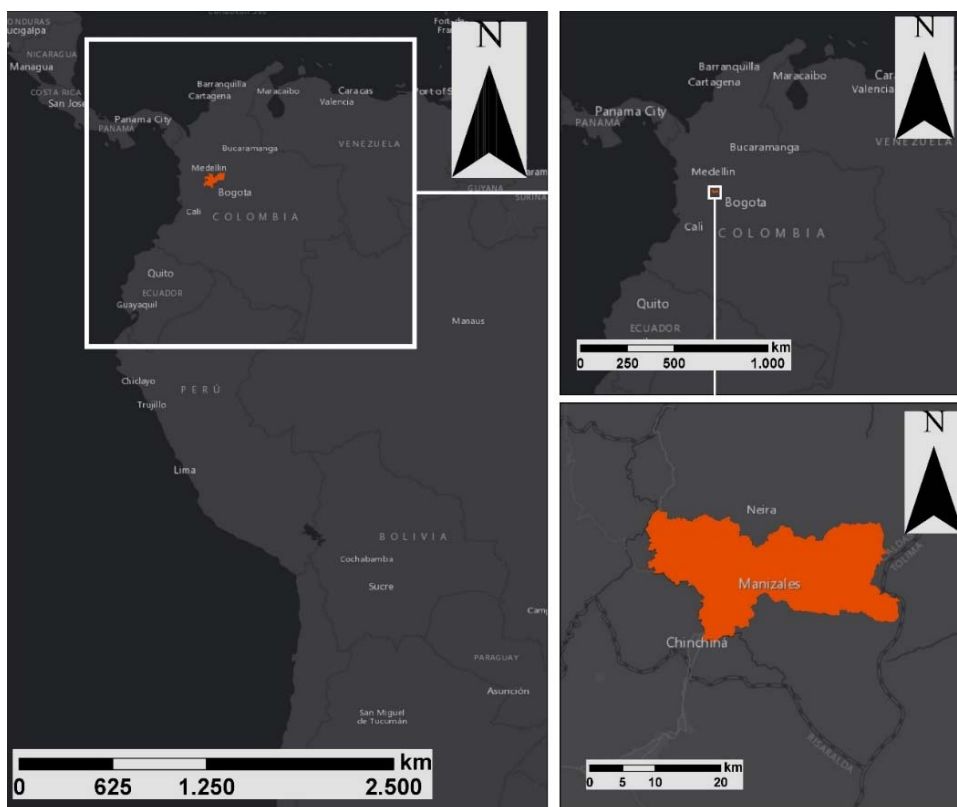

Figure 1. Manizales Location.

Next, the methodology carried out in the research will be described, followed by the presentation and analysis of results, closing with some conclusions.

2. Methodology

The research methodology (Figure 2) consists of 4 consecutive stages which are described below. Likewise, there is a preliminary stage of data collection.
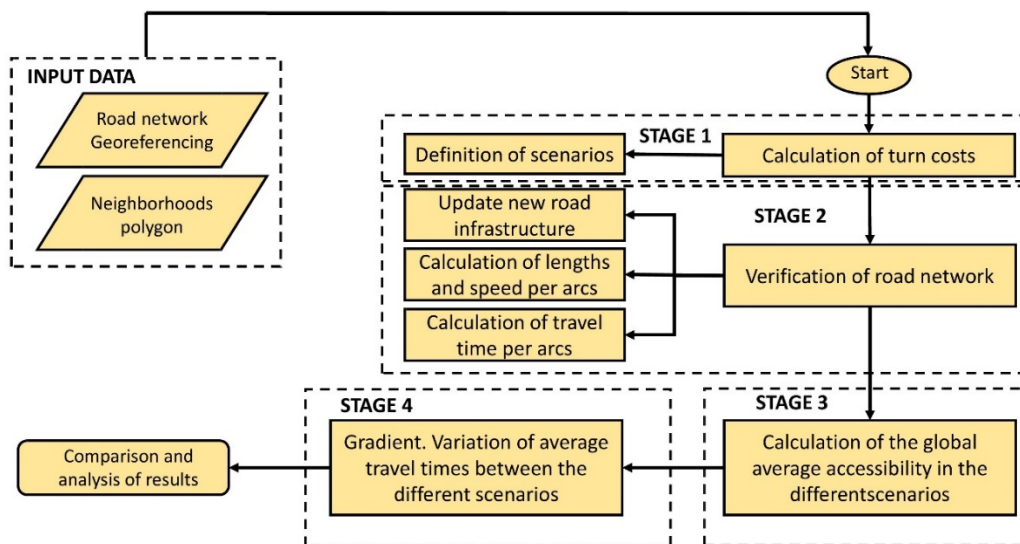

Figure 2. Research Methodology

2.1 Input Data

This stage, prior to the research methodology, the road network and the polygon of neighborhoods and communes of the city of Manizales georeferenced in GIS software are obtained. Firstly, for the subsequent calculations to be correct, the construction of the road network must comply with the theory of graphs focused on transport networks (Bunge, 1962, Cardozo, Goméz, & Parras, 2009), which was used in Previous investigations for the realization of the road network of Manizales (Escobar & Garcia, 2012). Secondly, the neighborhood polygon, which has data referring to the population and the socioeconomic stratum, must be updated according to the DANE population projections in order to make comparisons with the entire current population (Perilla et al., 2018).

2.2 Calculation of Turn Costs

In this section, the different analysis scenarios will be defined according to the penalties for subjective turn used up to now in the accessibility models for the city of Manizales and the penalties for turns calculated by the empirical methodology that is sought to be compared in this article, which are described below:

2.2.1 Scenario 1

This scenario represents the global average accessibility model calculated in previous research in the city of Manizales (Escobar & Garcia, 2012, Escobar et al., 2016, Moncada et al., 2018, Zuluaga & Escobar, 2017), where 1 min was used for the right turn and 1.15 min for the left turn as turn costs in the model, determined in a subjective manner. Therefore, this scenario will serve as a comparison basis to measure the variation with respect to the penalties calculated and used in scenario 2.

2.2.2 Scenario 1

This scenario corresponds to the global average accessibility, which includes the turn costs calculated using the empirical methodology developed in a Master's research at the National University of Colombia, Manizales, which is in publishing process. In this methodology 20 road intersections were studied, chosen through a prioritization analysis according to certain characteristics such as the type of intersection, type of traffic regulation, number of turns, location of the intersection and relationship with road safety audits. In the study, video records were taken, for their subsequent analysis, where the time of turning left and right was taken, making a statistical analysis (Schwar & Huarte, 1975) to finally determine the penalties in 0.49 min for the turn to the right and 0.58 for the left turn, as average values between the analyzed intersections, taking into account all types of vehicles.

2.3 Verification of Road Network

On this stage of the investigation, the road network obtained in the previous stage must be updated, introducing the new road infrastructure works put into action in the city and the different changes of directionality carried out by the municipal government in search of greater road organization (La Patria, 2016; La Patria, 2017). Likewise, the topology of the road network is verified by checking its construction according to the theory of graphs, which contains arcs and nodes (Perilla et al., 2018). Then, the lengths of the arcs are calculated with the help of the GIS software and the speeds are updated in some arcs of the network. Speeds were obtained by GPS in previous studies (Escobar & Garcia, 2012). Finally, at this stage the travel time for each arc (tvi) must be calculated using equation 1, where the length (li) and the particular speed of each arc (Vi) are related.

$$tvi = \frac{li}{Vi} \tag{1}$$

2.4 Calculation of the Global Average Accessibility

To calculate the global average accessibility of the different scenarios, several considerations must be taken into account. Firstly, the travel time matrix must be calculated, which contains the optimal route, minimizing the travel time between all the nodes of the road network. The calculation of the travel matrix is done in the GIS software, TRANSCAD 7.0, which has several tools for transport analysis, including "multiple paths" which uses the Dijkstra algorithm of minimum paths to know the optimal route, using travel time and global turn penalties as variables to be minimized (Dijkstra, 1959; Wu et al., 2015). It is at this point in the methodology that the penalty for turns is introduced for the scenarios to be analyzed. Then, the vector of average travel times ($\overline{Tv_i}$) must be obtained by means of equation 2, which relates all the travel times of node i to the rest of nodes j and divides them among the number of nodes it traveled (n - 1).

$$\overline{Tv_i} = \frac{\sum_{j=1}^{n} tv_{ij}}{n-1} \qquad i = 1, 2, 3, \dots, n; j = 1, 2, 3, \dots, n \tag{2}$$

With the vector of average travel times, a geo-statistical analysis is made by means of the ordinary Kriging method with linear semivariogram as a prediction model that will allow obtaining the isochronous curves of global average accessibility (Moncada et al., 2018). Geo-statistical methods have been used since the 60s in the field of geography (Matheron, 1963), the ordinary Kriging method has received special attention in transportation models (Aultman-Hall & Du, 2006; Lindner, Pitombo, Rocha, & Quintanilha, 2016; Perilla et al., 2018).

2.5 Saving Gradient

On the last stage, the two global average accessibility scenarios are shared through the savings gradient (SG (%)) (equation 3). To do this, the average travel time vectors of each scenario are used and the saving percentage is extracted, which will indicate the difference between the two. This method has been used in previous investigations to find the benefits in terms of average travel time for new infrastructure works (Perilla et al., 2018), changes in the direction of the road network (Escobar, Duque, & Salas, 2015), among others.

$$SG(\%) = \frac{\overline{Tv1} - \overline{Tv2}}{\overline{Tv1}} x100 \tag{3}$$

3. Results and Discussion

3.1 Global Average Accessibility, Scenario 1

Figure 3 shows the isochrones curves of global average accessibility for the municipality of Manizales corresponding to the calculation scenario 1 where the average travel times fluctuate between 20.5 minutes and 67.5 minutes. Likewise, in green tones, which occupy most of the study territory, average travel times of up to 42.5 minutes are found. On the other hand, the average travel times greater than 42.5 minutes correspond to the peripheral places of the city. Figure 4 shows the analysis of population and area coverage with respect to the isochronous global accessibility curves of scenario 1, where 98% of the population is covered by average travel times of less than 42.5 minutes, which corresponds to 410 050 inhabitants. On the other hand, in terms of the area, to reach 98% coverage (5 741 Ha) it is necessary 55 minutes of average travel time, which indicates that a large part of the population, 98% have time average of up to 45 minutes, is concentrated in 80% of the area (5 176 ha) which is covered by the same isochronous curve.
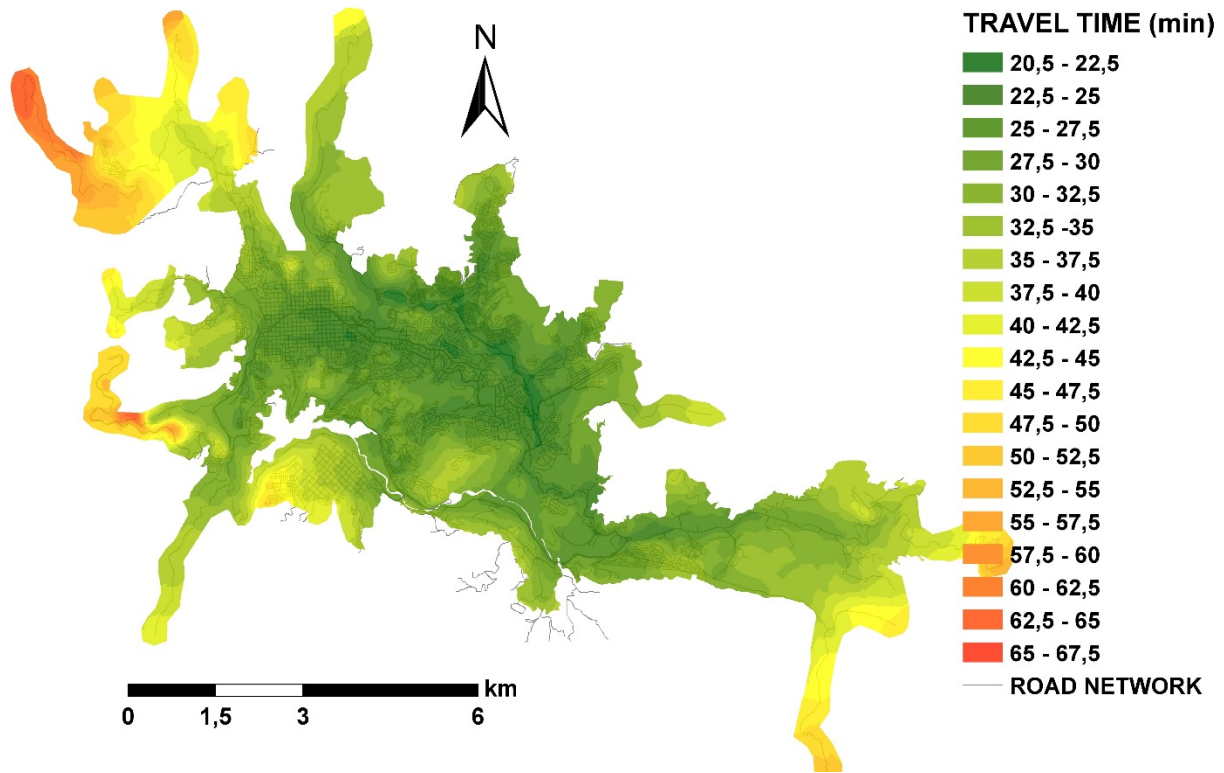
Figure 3. Global Average Accessibility, scenario 1
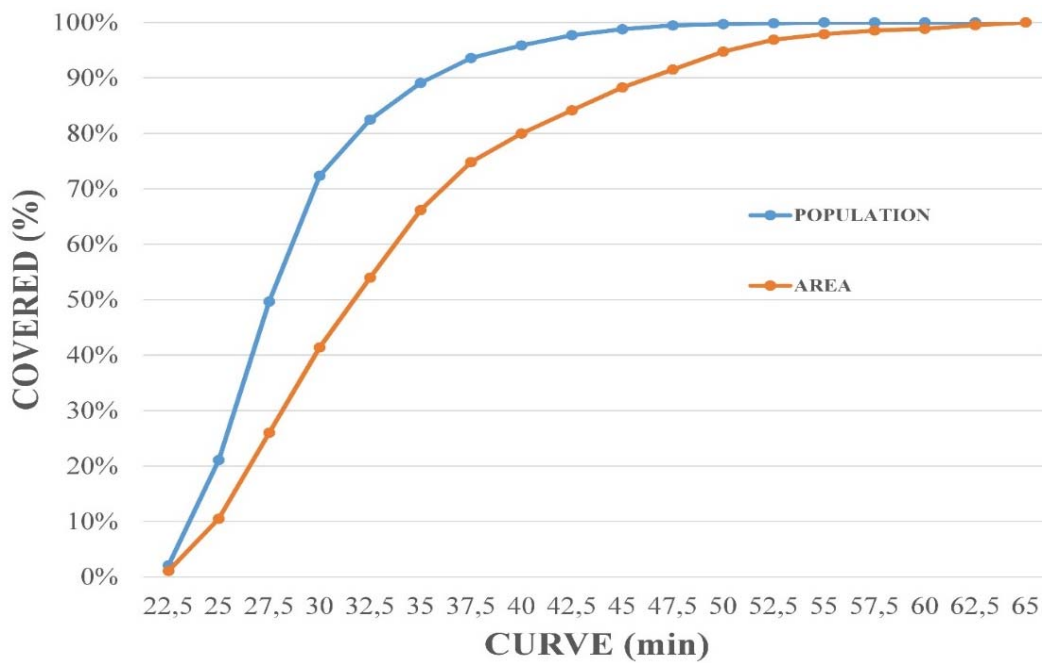
Figure 4. Isochrones curves (min) vs Covered porcentage of population and área, scenario 1

3.2 Global Average Accessibility, Scenario 2

Figure 5 shows the isochrones curves of global average accessibility for the municipality of Manizales corresponding to scenario 2 of calculation, where the turn costs taken empirically on intersections of the road network are used. Here, the average minimum travel time decreased 4.36 minutes compared to scenario 1, reaching 16.14 minutes. Likewise, the maximum average travel times decreased from 67.5 minutes in scenario 1 to 55 minutes in scenario 2, which indicates that the turn costs are a very important indicator in the calculation of

minimum routes and the travel times between nodes which causes that as the distances between nodes are greater, the difference between the scenarios are greater.
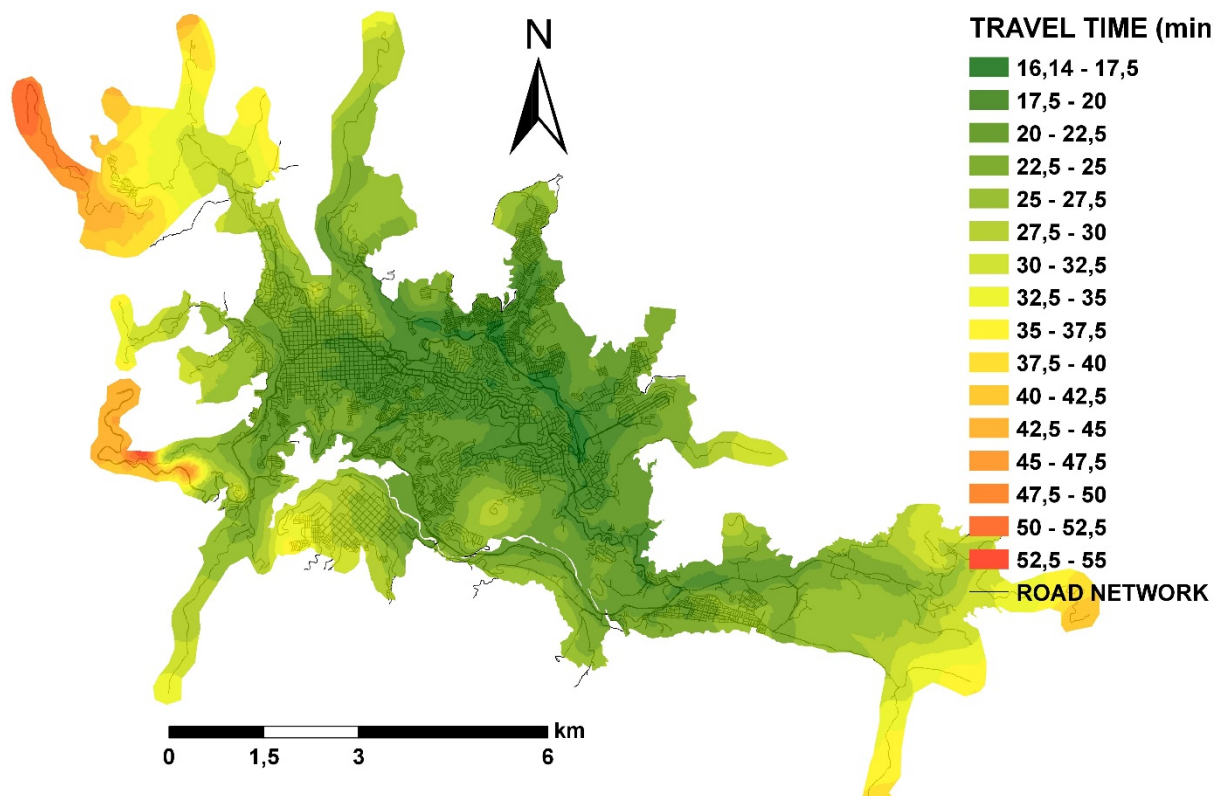
Figure 5. Global Average Accessibility, scenario 2

Figure 6 shows the analysis of population and area coverage with respect to the isochronous global accessibility curves of scenario 2. In this case, 98% of the population is covered by times less than 32.5 minutes, a decrease of 12.5 minutes regarding scenario 1. On the other hand, the population that perceives the average times greater than 32.5 minutes is less than 2% (9 363 inhabitants), the good general accessibility that citizens have in this city.
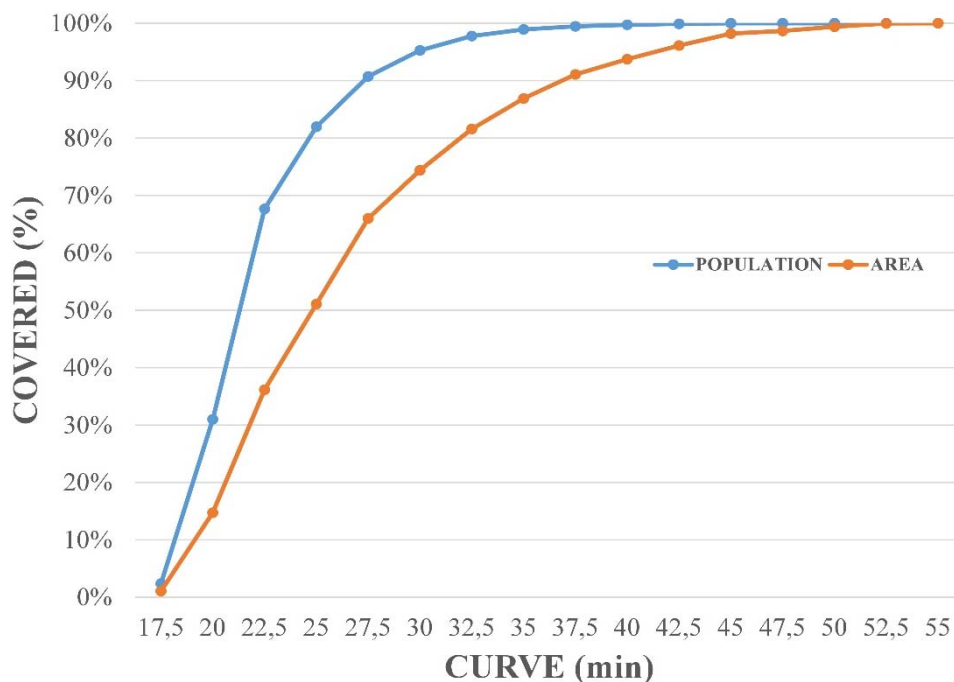
Figure 6. Isochrones curves (min) vs Covered percentage of population and area, scenario 2

3.3 Gradient, Scenarios Comparison

In Figure 7, the comparison of both scenarios is observed by means of the saving gradient, where the saving curves generated by the use of the empirical turnaround penalties are shown. There, savings are seen from 13.5% to 32% in the average travel time.
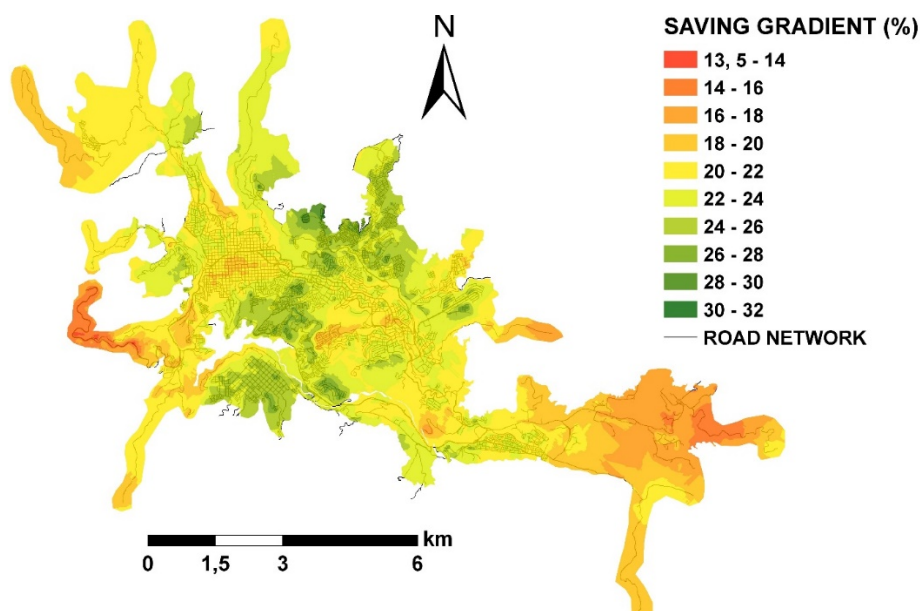
Figure 7. Saving Gradient

On the other hand, figure 8 shows the relationship between the percentage of population and area covered by the savings curves. Here we can see how 100% of the population and the area get savings of up to 14%. Likewise, 38% of the population (160 567 inhabitants) obtain differences in average travel times of up to 24%. This graph shows us the importance of having well calibrated the turn costs due to the differences that were generated between the analysis scenarios. Report any other analyses performed, including subgroup analyses and adjusted analyses,

indicating those that were pre-specified and those that were exploratory (though not necessarily in the level of detail of primary analyses). Consider putting the detailed results of these analyses on the supplemental online archive. Discuss the implications, if any, of the ancillary analyses for statistical error rates.

4. Conclusions

Firstly, the turn costs calculated through the empirical methodology were lower than those previously given in a subjective manner. Thus, the penalty for turning to the right went from 1 minute in the subjective scenario to 0.49 minutes in the calculated scenario. On the other hand, the penalty for turning to the left went from 1.15 minutes in the subjective scenario to 0.58 minutes in the calculated scenario. In both penalties, a difference of up to 51% is recorded with respect to scenario 1.

On the other hand, the differences registered in the calculated scenarios of global average accessibility of up to 12.5 minutes between the average times of maximum travel show the great importance of global turn costs.

Likewise, the savings gradient, method used to record the savings generated by road infrastructure interventions in previous research (Perilla et al., 2018; Moncada et al., 2018), works as a method to record the differences between the scenarios studied to determine the great importance of the turn costs in the global average accessibility model, in the calculation of the minimum road and the travel matrix.

Finally, for future research, it would be interesting to calibrate the model by means of the different travel times resulting in the time matrix, to find which of the scenarios is more in line with reality, the scenario of subjective penalties or the scenario of penalties calculated using empirical methodology.
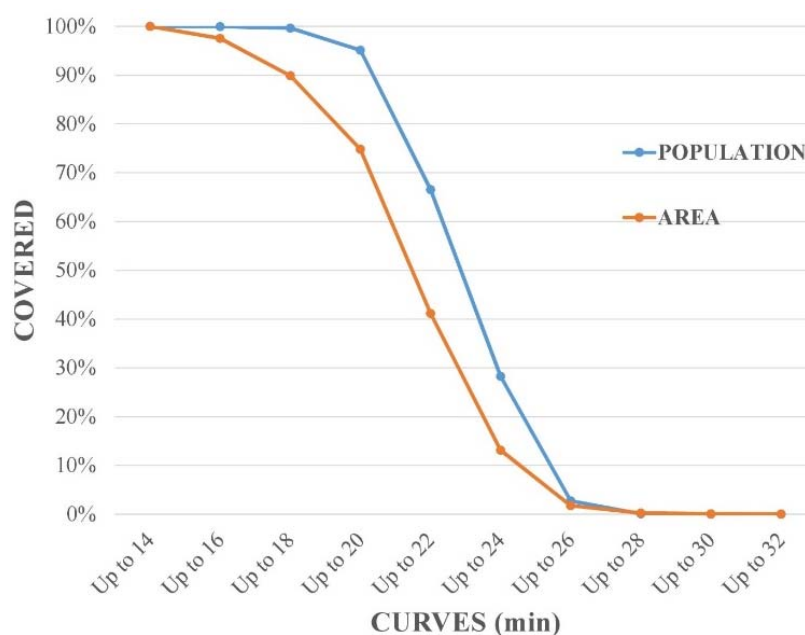

Figure 8. Saving curves (%) vs Covered percentage of population and area, saving gradient

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An Overview of Hadoop Scheduler Algorithms

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Abstract

Hadoop is a cloud computing open source system, used in large-scale data processing. It became the basic computing platforms for many internet companies. With Hadoop platform users can develop the cloud computing application and then submit the task to the platform. Hadoop has a strong fault tolerance, and can easily increase the number of cluster nodes, using linear expansion of the cluster size, so that clusters can process larger datasets. However Hadoop has some shortcomings, especially in the actual use of the process of exposure to the MapReduce scheduler, which calls for more researches on Hadoop scheduling algorithms.

This survey provides an overview of the default Hadoop scheduler algorithms and the problem they have. It also compare between five Hadoop framework scheduling algorithms in term of the default scheduler algorithm to be enhanced, the proposed scheduler algorithm, type of cluster applied either heterogeneous or homogeneous, methodology, and clusters classification based on performance evaluation. Finally, a new algorithm based on capacity scheduling and use of perspective resource utilization to enhance Hadoop scheduling is proposed.

Keywords: Hadoop scheduling, capacity scheduler, fair scheduler, FIFO scheduler

1. Introduction

The past decade has witnessed a rapid development of cluster computing platforms, due to the increased data sizes, known as big data, which require more scalable applications. Big data, cannot be handled using traditional database and software technologies due to its size, speed, and variety. For example, Google reported to process more than 20G of data per day, and Facebook reported that it handles between 15-20 terabytes of compressed data each day. This amount of data certainly cannot be handled by a single computer. It is also not feasible nor cost effective to handle big data with a single super high performance PC. Therefore, many models are designed to efficiently handle big data in parallel with business computer sets. For instance, the open-source Apache Hadoop has emerged as a de facto platform to handle large-scale, semi-structured and unstructured data (Brahmwar et al., 2016) (Al-Sayyed et al., 2017).

Hadoop is a reliable and scalable tool for distributed computing, data storage and processing. It is an open source program for writing and implementing applications in a group. Hadoop and Hadoop are sources accessible to Mapreduce and Google's file system. Hadoop was originally implemented in Java (Hamad, & Alawamrah, 2018). Applications in Hadoop can be written in different programming languages. When programmers write applications using the map and reduce functionality, the Hadoop framework automatically performs these functions in parallel. Hadoop was first created by Doug Kuting in 2004 and was developed primarily by Yahoo. Its streaming utility allows the user to create and run functions using any executable map and reduction functions. Apache Hadoop System is a Mapreduce project that was developed in Java by the Apache Foundation. As Hadoop is published under the Apache license, the Hadoop source code is available for public download. Hadoop is deployed in Yahoo servers, where hundreds of terabytes of data are created on at least 10,000 cores. Facebook makes use of Hadoop packages to handle more than 20 terabytes of new data per day. Other web giants such as Amazon employ ad hoc groups to manage massive amounts of data on a daily basis (Guo et al, 2015) (Hudaib, et al., 2016).

The Hadoop system contains two basic components. The first component is a distributed file system called HEDFES; and the second is the Mapreduce programming framework for processing large data sets. The implementation of Hadoop MapRedus is designed for large groups, and targets distributed file system (i.e. HDFs), In most Hadoop functions, HDFs is used to store both inputs from the map and output tasks by

minimizing tasks (Zaharia et al, 2010).

Hadoop has two layers; on top, a Mapreduce engine that contains tracker function and tracker functions; and the bottom, HDFs, contains NAMnode and Datanodes. Each node can act as master or slave in relation to both Hodges and Mapreduce. The default Hadoop messages are shown in figure 1.
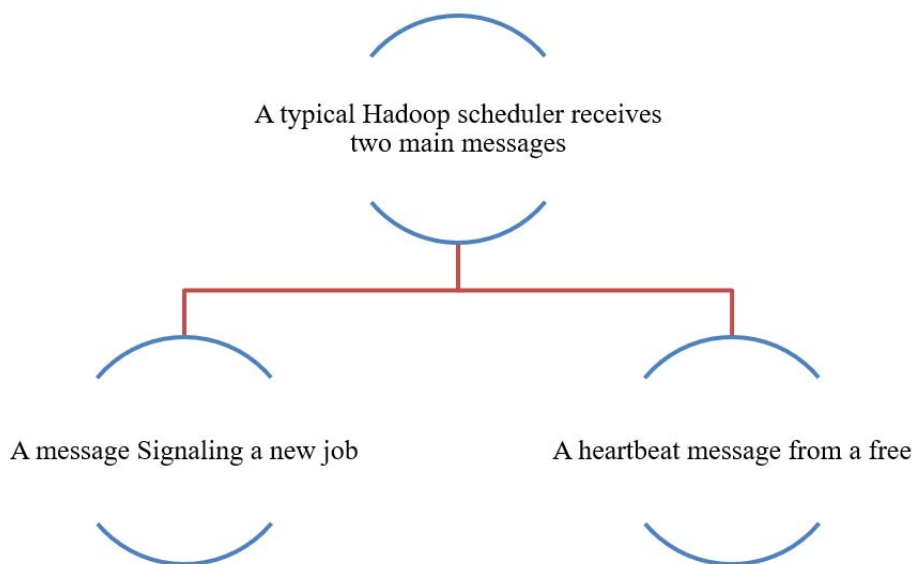
Figure 1. Hadoop typical scheduling massages

Hadoop has its own file system known as HDVs. HDF provides high productivity access to the application and is designed to store large files with the flow of the data access pattern and run on cluster devices. Monitor constantly monitors the server to ensure data availability. The HDVs are designed to predict failures in the commodity machinery groups in order to tolerate and compensate for all those failures. The main benefit of HDFs is that the software itself deals with hardware issues, freeing users of having to worry about system failure.

1.1 Characteristics of Hadoop

The main characteristics of Hadoop are:

> *Accessibility and Cost Effectiveness:* it is the best approach for solving big data set problems isong a range of commodity machines. It has been used as a cloud computing service, for example. Amazon Web Services (OS) (Al-Sayyed et al., 2017).

> Scalability: Hadoop is a highly scalable model that can be used as a classroom research tool in colleges, or as a terabyte of data storage and analysis as in Yahoo, Facebook or Amazon. If more capacity is needed, it can be added as required (Reddy, et al, 2011).

> *General Purpose:* Hadoop is a powerful and easy tool for programming. Even new or non-programmers can write and execute parallel code in a simple way (White, 2012).

> *Low barrier entry:* Hadoop does not need any schema or database in the front. All users are able to easily download and use raw data.

However, Hadoob has many issues and challenges associated with the scheduler research and management in cluster computing frameworks for large-scale data processing. For instance, Clauser's distinctive computing platforms, such as Haddob, were deliberately designed to improve liberal liberalism or a range of large functions. (Rasooli, & Down, 2011). Moreover, cluster computing platforms serve diverse workloads of deferred and deferred sources. These workloads usually have important considerations in the underlying performance. For example, interactive applications that require good response times while making a period or deadlines are more important for periodic batch jobs. There is no single resource management schema or scheduling applications that are optimized for all performance metrics (Bhosale & Gadekar, 2014). The original Vivo scheduling policy is designed by Hadoop Mapreduce to make a better payment. However, the response time of short functions is sacrificed when applications are introduced behind long intervals. Scheduling such as fair and resource sharing

capabilities is designed between users and applications that support equity and provide better performance for short applications. However, they are not optimal in terms of response times for work or productivity (Yong, Garegrat, & Mohan, 2009) (Hamad, & Adwan, 2018).

Dependency between tasks is another issue with Hadoop. While large functions are broken in small tasks for parallel performance, there are usually dependencies between functions in most cluster computing applications. In the Hadrid Mapredus platform, task reduction depends on the map functions of the same function since performing task reductions based on the average data produced by map tasks. The data transfer process is called in the Mapreduce mix. In the traditional definition of task dependency, when the task depends on others, the start time cannot be earlier than the completion of any of its subordinate tasks. However, in the Iron Mapreduce platform, the reduction of tasks actually begins earlier (He et al, 201). The reason is that the dribbling process is one with reducing tasks under the center, such that starting to reduce tasks earlier can help improve performance by interfering with Xu progress with the progress of the map, i.e. keeping the intermediate data produced by the map tasks done while other map tasks are still running or waiting. In other frameworks, there may be more complex dependencies between tasks in each job. Types of deferred tasks for cluster computing applications are typically resource-driven. For example, in the Mapreduce framework, each application has two main phases, the map and the minimization (DeWitt, & Stonebraker, 2008).

There can be multiple independent tasks that perform the same functions at each stage, i.e. mapping tasks and reducing tasks. These two types of tasks are often quite different resource requirements. The mapping tasks are typically intensive for the CPU while reducing intensive I/O tasks, especially when the middleware map designers are brought in. System resources can be efficiently used if maps and task reduction work concurrently on a worker's contract. To ensure the best use of resources, the first generation aims to distinguish the important tasks of the map/reduce tasks by configuring a different map/reducing slots on each node (Rao, & Reddy, 2012). The concept of time interval is to extract node capacity where each map/time interval accommodates at least one map/reduces task at any given time (Al Khattab, Aet al, 2015). By setting the number of map /reducing slots on each node, the Hadoop platform controls the synchronization of different types of tasks in the cluster to achieve better performance. The second-generation system of Hadoop-Yarn adopts the management of granular resources where each task needs to explicitly define its demands on different types of resources, i.e. CPU and memory. The resource manager therefore benefits from heterogeneous resource requirements and uses the resources of the group more accurately and efficiently (Kc and Anyanwu, 2010).

Moreover, many current resource management schemes cannot fully benefit from group resources. For example, a Twitter production group managed by Missus reported that the total CPU utilization is less than 20% and Google system reported a combined CPU usage of 25-35%. One of the main reasons for this is that existing resource management schemes always maintain a fixed amount of resources for each task as requested by their resources. However, note that the tasks of different data processing frameworks and applications can have different patterns to use resources. For example, many tasks of cluster computing applications consist of multiple internal phases and have relatively long execution times. These tasks usually have a variety of resource requirements during execution. As discussed above, minimizing tasks in the framework of MapRedus is usually less CPU usage at the shuffle stage, i.e. fetching intermediate data, when waiting for map tasks to generate outputs (Hudaib, & Fakhouri, 2016).

Another example is Spark's tasks. When deployed on the Yarn system, Spark's mission is to host multiple user-defined stages that also require different types and amounts of resources. Moreover, when Spark tasks serve an interactive function, the use of resources from these tasks can often change, for example, being completely idle during the user's thinking time, and become busy and requesting more resources. Similarly, frames that handle data flow may maintain a large number of functions alive and wait for input. Therefore, resource requirements must change over time when new incoming data arrive, which unfortunately cannot be predicted. Although short tasks dominate many cluster computing clusters, the long-term effects of long-term tasks on the use of system resources are negligible given their high resource demands and the long occupation of resources. In such cases, the allocation of resources during the lifetime of the task becomes ineffective to take full advantage of system resources (Chen et al., 2010).

The default scheduler assumes that the cluster environment is designed to be homogeneous so that all nodes in the cluster have the same computation and configuration capacity. However, the real world applications work in a heterogeneous environment. Accordingly, the overall performance of the Hadoop fails if it continues to use the default schedule policy in a heterogeneous environment. Moreover, some tasks take longer time to perform compared to other tasks on the same node. Such tasks are called stragglers. These are responsible for lengthening task execution time. To solve this issue, Hadoop Mapreduce run the backup task of the slow task on another node

that has a faster account in order to prevent slow tasks of lengthening the overall execution time of work.

2. Overview of Default Hadoop Scheduler Algorithms

2.1 FAIR Scheduler

Scheduling in Hadoop organizes functions in categories, including shared resources. Each pool is allocated a guaranteed minimum share, ensuring that certain users or applications always have adequate resources. Fair sharing also works with work priorities, which are used as weights to determine the part of the total time allocated to each post. The fair scheduling determines the resources for posts so that all posts, on average, consume an equal share of resources. For example, if queue1 gets 80% of clusters and queue2 gets 20% of clusters, then a high priority task goes to queue1 (Zaharia, 2009).

The Gallery Scheduler allows all functions to be run by a default or specified configuration file, limiting the number of jobs per user and per pool. This configuration file is very useful in two specific situations. First, the user tries to provide hundreds of jobs at once. Second, many functions simultaneously run cause high context switching overhead and a huge amount of intermediate data. Reducing the number of jobs running, of course, does not cause any later functionality provided for failure. However, you must wait for the newly arrived jobs in the Scheduler queue until some of the running functions are finished (Usha, & Jenil, 2014).

2.2 Capacity Scheduler

Capacity Scheduler is developed by Yahoo for a large collection of resource sharing. The functions are organized and placed in multiple queues, each of which is secured to reach a fraction of the mass capacity (i.e. number of task slots). All posts submitted to a particular queue guaranteed resources for this queue. If tasks of functions in queues have extra capacity it kills tasks. Free resources can be allocated to any queue beyond its capacity. When there is a demand for resources from queues operating under capacity at a later time (e.g. scheduled tasks on full resources), resources will be allocated to posts on queues operating under capacity. If inactive queues start to get work requests, their lost capacity will be rolled back.

Queues can also support priorities for posts that are disabled by default. In the queue, high priority jobs have access to queue resources before getting jobs with lower priority. However, once a function is run regardless of its priorities, task will not be pre-empted by any higher priority function. However, the new tasks of the highest priority function will be predefined in the queue. To prevent one or more users from monopolizing resources, each row assigns a percentage of the resources allocated to a user at any given time, if all users are using resources (Ghemawat, , Gobioff, & Leung, 2003). .

Whenever TaskTracker is a free, scheduling capabilities select queue with most free resources. Once the queue is selected, a scheduler selects a task in the queue according to the priority of the task. This scheduling mechanism ensures that there is enough free memory in TaskStaker to run the task in case the task has significant memory requirements. In this way, resource requirements can always be met immediately (Dean, & Ghemawat, 2010).

2.2.1 I Capacity Scheduler

Icapacity scheduling puts jobs into varied queues in accordance with the conditions, and allocates certain system capability for each queue. If a queue has serious load, it seeks unallocated resources, then makes redundant resources assigned equally to each job. It re-allocates the resources for empty queue to queues exploitation for maximizing resource. Once jobs arrive therein queue, running tasks square measure completed and resources square measure given back to main queue. It conjointly permits priority based totally programming of jobs in associate organization queue. To use icapacity dynamic scheduler, the subsequent property has to be set in yarnsite.xml like below: yarn. resourcemanager. schedular.class org.apache.hadoop.yarn.server.resourcemanager.sche dular.capacity.CapacitySchedular.

2.3 Hadoop Scheduling Algorithm Framework

Five scheduling algorithms have been selected in order compare between Hadoop scheduling algorithms framework in term of the proposed scheduler algorithm, the default scheduler algorithm that has been enhanced, the type of cluster applied; either heterogeneous or homogeneous, methodology, and clusters classification based on performance evaluation. See table 1. Five selected schedulers will be briefly discussed.

2.3.1 Tolhit – A Scheduling Algorithm for Hadoop Cluster (2016)

Tolhit uses the usage of resources and network information from cluster nodes to find the optimal node for scheduling a speculative version of a slow task. The performance of the proposed scheme has been evaluated through a series of experiments (Brahmwar, Kumar, & Sikka, 2016).

The name "Tolhit" comes from the algorithm ability to use more accurate phase weights to provide an estimation to the operation of tasks. Resources from cluster nodes such as Ram & Disk usage is also maintained and updated periodically in resource info. Parameter for Disk usage by the node is calculated by looking only at input and output requests from the running tasks on that node (Brahmwar, Kumar, & Sikka, 2016).

The proposed algorithm maintains history information of the date when each node is present in the cluster. Each record contains historical information about any map (M1 and M2) and reduces phase weights (R1, R2, and R3). Tolhit assumes the implementation of the map function Weight as M1 and then reorder the medium weight of the result as M2 of the map task. R1, R2, R3 stand for the copy, sort and reduce phase weights from task minimization. The date information stored on each node is sorted using genetic (13) to any of the clusters. If the ongoing work satisfies the extant (threshold for the task map Detection) on a data node, then the algorithm assigns a temporary task to the phase weight map (M1). The map phase weight is used as a search parameter to determine the block with the nearest map phase weight (M1) between (K) in historical information (Brahmwar, Kumar, & Sikka, 2016).
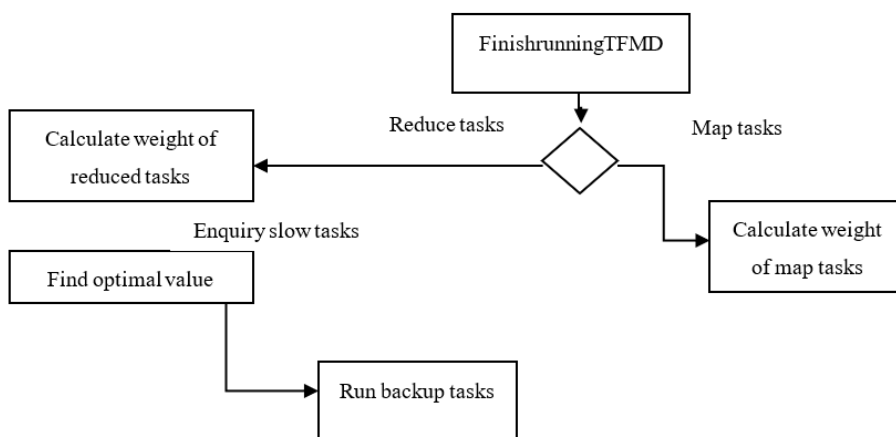
Figure 2. Tolhit algorithm flow chart

2.3.2 COSHH

The scheduling system, named COSHH, is considered heterogeneous for both application and mass levels. The goal of COSHH is to improve the average time of completion of employment. The high-level architecture of COSHH is displayed in the Figure.3 while COSHH Queuing Process are displayed in figure 4 (Rasooli, & Down, 2014).
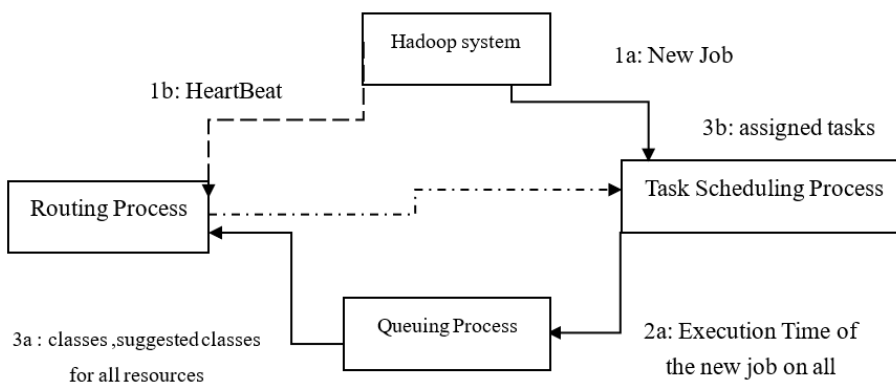
Figure 3. The high-level architecture of COSHH.
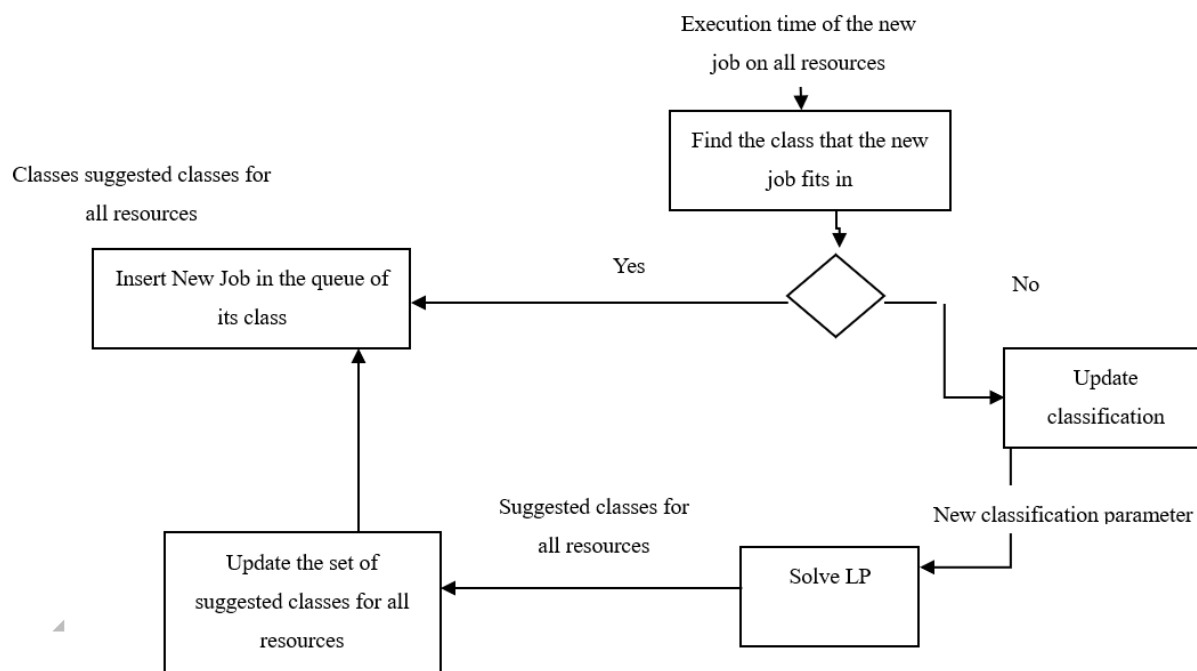
Figure 4. COSHH Queuing Process

The Hadoop Model Scheduling receives two key messages From the Hadoop system: A m`essage refers to a new job Access from user, heartbeat message from free Resources. Therefore, COSHH consists of two main supporters, Sys, where each process is run by receiving one of the messages. When you receive a new functionality, schedule lead the queue process to store the incoming function in Suitable queue. When receiving heartbeat mes-SAGA, scheduling causes the routing process to be set Function to the current free resource.

2.3.3 An Adaptive Scheduling Algorithm for Dynamic Heterogeneous Hadoop Systems

Rasooli &. Down, (2011) designed a scheduling algorithm which classifies the jobs based on their requirements and finds an appropriate matching of resources and jobs in the system. The algorithm is completely adaptable to any variation in the system parameters. The classification part detects changes and adapts the classes based on the new system parameters. Also, the mean job execution times are estimated when a new job is submitted to the system, which makes the scheduler adaptable to changes in job execution times. A high level view of Dynamic Heterogeneous Hadoop Systems is shown in Figure 5.

This scheduling algorithm uses system information such as estimated access rates and times to make scheduling decisions. The goal of this algorithm is to improve the average time of completion of the submitted jobs. It receives a typical two Hadoop schedule Key Messages: New Access Message from user and heartbeat message of free re-charging source. When the scheduler receives a new functionality from a user, the scheduler queue the process and store the incoming function in the appropriate queue.

Let:

- $JobClasses1 = \{C_1, \ldots, C_n\}$, where C_i represents a class of jobs whose minimum share > 0, and share similar arrival rates, estimated execution rates, and priorities.

- $JobClasses2 = \{C'_1, \ldots, C'_n\}$, where C'_i represents a category of all the jobs in the system with similar arrival rates, estimated execution rates, and priorities.

Upon receiving a message (either a "job arrival" from a user or a "heartbeat" from a free resource) from the Hadoop system:

- If incoming message = job (say J) arrival

  1. Get the estimated execution time of J from the Task Scheduler component.
  2. Check if J fits in the current job classification
      (a) If J fits in any class (say C_i)
          i. add J to the queue of C_i
      (b) Else
          i. update the job classification by adding a new class for J (say C_j)
          ii. add J to the queue of C_j
          iii. find a matching of classes and resources using an optimization approach, which results in two sets of suggested classes for each resource as follows:

          $$SC_R = \{C_1, \ldots, C_n\}, \text{ where } C_i \in JobClasses1$$
          $$SC'_R = \{C'_1, \ldots, C'_n\}, \text{ where } C'_i \in JobClasses2$$

- If incoming message = heartbeat from a free resource (say R)

  - For each free slot in the resource R (say S_R):

  1. Look for a job where

      $$job.user.min\_share - job.user.currentshare > 0$$
      and
      $$job.class \in SC_R$$
      and
      $$((job.user.min\_share - job.user.currentshare) \times priority) \text{ is maximum}$$

  2. If no job is found, look for a job where

      $$job.class \in SC'_R$$
      and
      $$(job.user.currentshare/priority) \text{ is minimum}$$

  3. If a job is found (say $J_{selected}$), send S_R and $J_{selected}$ to the Task Scheduler. The Task Scheduler chooses a task from $J_{selected}$ and assigns it to S_R.

  4. If no job is found, S_R will left unassigned until the next heartbeat message.

Figure 5. A high level view of Adaptive Scheduling Algorithm for Dynamic Heterogeneous Hadoop Systems

When a heartbeat message arrives from a resource, scheduling prompts the CES to assign a function to the free resource. The algorithm uses a classic function, so when new function up to the system, the queue process-specific class of this function, stores post in the queue of its class. Column A process that sends updated information to everyone and chapters to the routing process, where this routing process uses information for selection Function of current free resources.

2.3.4 Dynamic Capacity Scheduling in Hadoop

Thakur, Singh & Sharma, (2015), aimed in their work decrease the completion time of reduced tasks in map-reduce framework. They tend to organized yarn-site.xml file in Hadoop and additional property values for capacity scheduler. By adding properties for icapacity scheduler we tend to inform to icapacity scheduler algorithmic program, the properties of that are organized in ICapacity-scheduler.xml. The following algorithm of icapacity scheduler is used in which first we initialize the queue, second collect the running container then add to the scheduler. It kill the container, if a queue is below capacity because of lack of demand, and so demand will increase, the queue can solely come to capacity as resources area unit discharged from different queues as containers complete as shown in figure 6.

Initialize from Config file

Minimum allocation, maximum allocation, node locality, threshold

Initialize queues

For (Csleaf Q: queueManager)

{ Resource. add (resTopreempt)

If (Resource greater than Resource Calculator)

Preempt + resource (quemagr. Get LeafQueue)

// collect running container

for (sched: scheds)

{ If (Resource. greater than Resource Calculator)

{ for (appsched: sched.getAppSchedulable)

{ For (RMContainer: getLiveContainer)

{ Running container. add(c)

Apps.put (c, appsched.getApp ())

Queues. put (c, sched) }}}

//kill container

If (time! = null)

{ If (time + waitTime BeforeKill < clock.getTime ()) Create preemped container Status (container .getContainerId ()) CompletedContainer (containers, status, RMcontainer.KILL)

Figure 6. ICapacity scheduler algorithm

2.3.5 The Improved Job Scheduling Algorithm of Hadoop Platform

In the Improved Job Scheduling Algorithm of Hadoop Platform, the scheduling algorithm based on Bayes Classification where the jobs in job queue are classified into bad job and good job by Bayes Classification. When JobTracker gets task request, it will select a good job from job queue, and select tasks from good job to allocate JobTracker, then the execution result will feedback to the JobTracker. Therefore the scheduling algorithm based on Bayes Classification influence the job classification via learning the result of feedback with the JobTracker will select the most appropriate job to execute on TaskTracker every time. the feature usage are considered for job resource and the influence of TaskTracker resource on task execution, the former of which we call it job feature, for instance, the average usage rate of CPU and average usage rate of memory, the latter node feature, such as the usage rate of CPU and the size of idle physical memory, the two are called feature variables. These two types of feature variable are: 1) Job feature that mainly describes the resource usage situation of job. The value of the variable can be set when the user commits job or obtained via analysis the history information of job execution. The variable values are set from 10 to 1, and 10 is the maximum value which represents the utmost using of resources, 1 corresponding to the minimum value which represents the min usage of resources. The feature variables average CPU usage rate of job, average network usage rate, and average usage rate of IO and average memory usage rate will be adopted. 2) Node feature that represents the computation resource state and quality on a TaskTracker computing node. The variable can be divided into static feature variable of node and dynamic feature variable of node. The static feature variable refers to feature variables which stay static or are constants, while the dynamic feature variable refers to those node properties which change frequently along with time (Guo, Wu, Wu, & Wang, 2015).

With Job scheduling algorithm based on Bayes classification the administrator can adjust task allocation policy through learning the feedback result of every task allocation decision to cluster resources to affect or adjust later allocation strategy constantly. This is accomplished without knowledge of the resource using feature of MapReduce job and resource of TaskTracker on the cluster to improve the correct rate of task allocation and then provide the most system availability. At the end it can reduce administrator's burden, improve management efficiency and reduce the possibility of human error obviously, (Guo, Wu, Wu, & Wang, 2015).

Table 1. Comparison between scheduling algorithms (Tolhit, COSHH, An Adaptive Scheduling Algorithm for Dynamic Heterogeneous Hadoop Systems, Dynamic Capacity Scheduling in Hadoop, The Improved Job Scheduling Algorithm of Hadoop Platform)

	Tolhit (Brahmwar, Kumar, & Sikka, 2016).	An Adaptive Scheduling Algorithm for Dynamic Heterogeneous Hadoop Systems. (Rasooli, & Down, 2011).	COSHH, (Rasooli, & Down, 2014)	Dynamic Capacity Scheduling in Hadoop. (Thakur, Singh & Sharma, 2015).	The Improved Job Scheduling Algorithm of Hadoop Platform. (Guo, Wu, Wu, & Wang, 2015).
Proposed work	An algorithm to assist the scheduler in identifying the nodes on which stragglers can be executed so that the overall delay can be reduced.	A new scheduler algorithm to improve mean completion time of submitted jobs.	Design and implement a new Hadoop scheduling system, named COSHH.	Introduced pipeline and queue management in proposed work for improving the performance of Hadoop.	Jobs scheduling optimization algorithm based on Bayes Classification.
The default scheduler algorithm that to be enhanced	Fair Scheduler (HFS).	Fair scheduling	Fair scheduling	Improved capacity scheduler	Fair scheduling
Enhancement	Execution time	Mean completion time of submitted jobs	Improve the mean completion time of jobs.	Improve the existing scheduler issues that help the scheduler to execute the task in less time.	Improvement in execution efficiency and Stability of job scheduling.
Cluster applied to: heterogeneous or homogeneous	Heterogeneous.	Heterogeneous.	Heterogeneity at both the application and cluster levels.	Heterogeneous.	Heterogeneous.
Objective	Aid the scheduler In identifying the nodes on which stragglers can be executed and to solve the stragglers problem.	Improve mean completion time of submitted jobs.	Improve the mean completion time of jobs.	Improve the existing scheduler issues to minimize the scheduler execution time.	Redesign scheduling algorithm based on Bayes Classification and review the shortcomings of the used algorithms.
Methodology	Maintains historical information for every node present in the cluster. Each record in the historical information holds 5 values i.e. map (M1 & M2) and reduce stage weights (R1, R2 & R3). Tolhit assumes "Map function execution weight "as M1 and "Reordering intermediate results weight "as M2 of a map task. R1, R2, R3 stand for the copy, sort and reduce stage weights of reduce task. The history information stored on every node is classified using Genetic algorithm based clustering scheme into k no of clusters.	Uses system information such as estimated job arrival rates and mean job execution times to make scheduling decisions.	COSHH consists of two main processes, where each process is triggered by receiving one of These messages. Upon receiving a new job, the scheduler performs the queuing process to store the incoming job in an appropriate queue. Upon receiving a heartbeat message, the scheduler triggers the routing process to assign a job to the current free resource.	initialize the queue, second collect the running container then add to the scheduler .It kill the container, if a queue is below capacity because of lack of demand, and so demand will increase, the queue can solely come to capacity as resources area unit discharged from different queues as containers complete.	the scheduling algorithm based on Bayes Classification influence the job classification via learning the result of feedback with the JobTracker will select the most appropriate job to execute on TaskTracker every time
performance evaluation	The simulations were done on a 5 node heterogeneous cluster. The performance evaluation of the proposed scheme has been done by series of experiments.	Using simulation, demonstrate that the algorithm is a very promising candidate for deployment in real systems.	However, as it is concerned with other key Hadoop Performance metrics, our proposed scheduler also achieves competitive	Experimental result show that the proposed strategies can result in about 29 to 50 % decrease in average response time.	Not mentioned

	From the performance analysis 27% improvement in terms of the overall execution time	performance under minimum share satisfaction, fairness and locality metrics with respect to other well-known Hadoop schedulers.

3. Proposed hadoob Scheduler Algorithm

At present, the common scheduling algorithm mainly has the default scheduling algorithm FIFO, which adopts a single advanced First out of the queue, regardless of the size or priority of the job, the efficiency is low. The inefficiency and the right Heterogeneous system demand new scheduling algorithms

For this we propose a new scheduling algorithm, from the perspective of resource utilization, that enhance the capacity scheduling algorithm based on the best job priority, resource requirements, node distance to calculate the weight of the job, while observing the real-time and feedback execution status of the jobs , and this will adaptively adjust the node workload, to achieve the task scheduling process load balancing, so as to improve the efficiency of the task scheduling of the cluster.
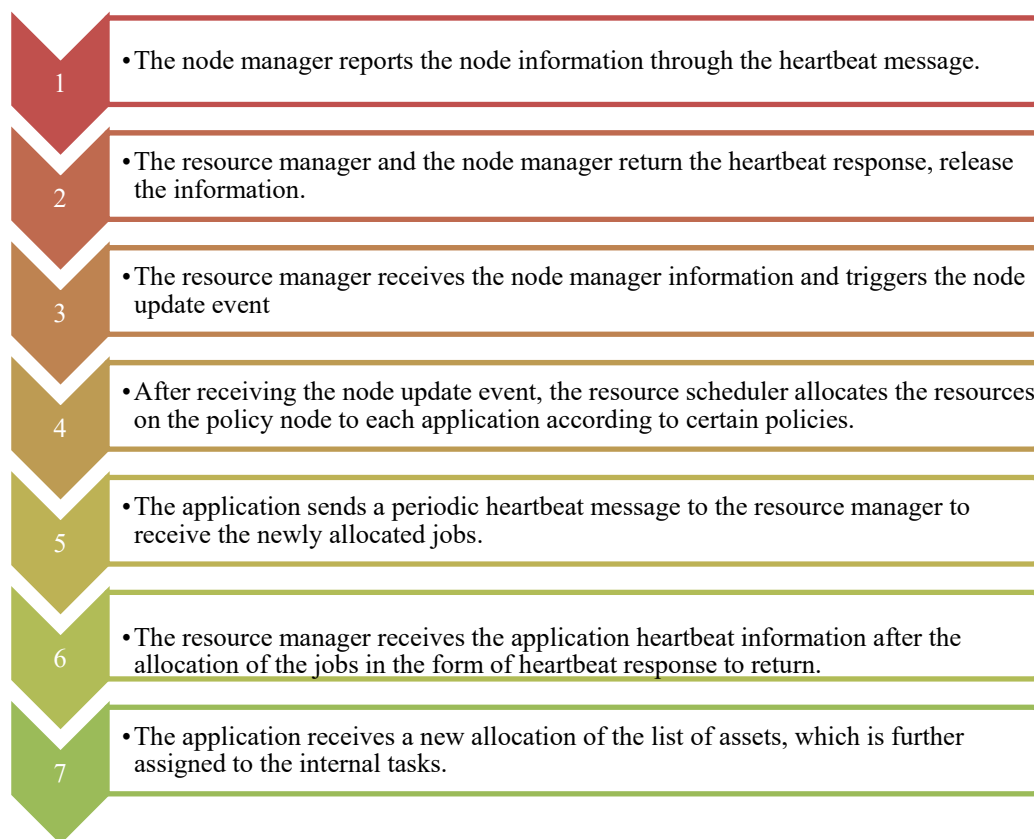
3.1 The Proposed and Improved Algorithm: Weighted Capacity Scheduling Algorithm

In the original algorithm, the job queue is sorted by job submission time and job priority, and then the queue header job is selected. The proposed algorithm first sorts the jobs for each queue according to the job weights, and then allocates the idle slots to the first queue for a job. Therefore, the choice of job weight in the proposed algorithm is an important reference for job scheduling.

In order to avoid long-term waiting for the scheduling task, the proposed algorithm optimizes the order of the jobs in the allocation step, that is, according to the actual status of the job execution, in order to dynamically adjust the weight of the jobs. And this is done by analyzing the weight order, by computing the average of the requested resource size.

To discuss the proposed algorithm in more details we will first describe the resource scheduling model:

The organization and distribution management of cluster resources is one of the most basic functional modules in the Hadoop system. The process can be summarized as shown in figure 7:

1. • The node manager reports the node information through the heartbeat message.

2. • The resource manager and the node manager return the heartbeat response, release the information.

3. • The resource manager receives the node manager information and triggers the node update event

4. • After receiving the node update event, the resource scheduler allocates the resources on the policy node to each application according to certain policies.

5. • The application sends a periodic heartbeat message to the resource manager to receive the newly allocated jobs.

6. • The resource manager receives the application heartbeat information after the allocation of the jobs in the form of heartbeat response to return.

7. • The application receives a new allocation of the list of assets, which is further assigned to the internal tasks.

4. Summary and Findings

Scheduler of jobs in hadoop to better evaluation plays a major role in enhancing the performance hadoob in general, in this paper we have studied hadoop scedular algorithms, we provided an over view of hadoop and hadoop scheduler algorithms then we have introduced and compare five of the state of art scheduling algorithms to improve that enhance the speed of Hadoop framework , we compare these algorithms in term of The proposed scheduler algorithm, The default scheduler algorithm that is enhanced, Cluster applied to : heterogeneous or homogeneous, methodology, clusters re classification according and Performance evaluation. The compared algorithms focused on reducing the time needed to execute the job with taking into consideration the fairness between the jobs, the algorithms have enhanced the default hadoop scheduler algorithms (fair scheduler, capacity scheduler), we have seen that the field of scheduling in hadoop is a promising research area that need more researches to enhance the hadoop scheduling algorithms.

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Theoretical Investigation of the Electronic Structure of the Strontium Mono-Sulfide Molecule SrS Using the ab initio Calculation Method

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Abstract

The ground state and 23 other low-lying singlet and triplet electronic states of the strontium mono-sulfide molecule SrS, in the $^{2s+1}\Lambda^{\pm}$ representation, have been examined by *ab initio* calculations using the computational chemistry software MOLPRO and the graphical user interface GABEDIT. The potential energy curves, in terms of the internuclear distance R, resulted from the complete active space self-consistent field (CASSCF) and multi-reference doubly and singly configuration interaction (MRDSCI) with Davidson correction (+Q) calculations. The permanent dipole moments (μ) and the spectroscopic constants (T_e: the electronic energy with respect to the ground state, ω_e: the harmonic frequency, R_e: the equilibrium internuclear distance, B_e: the rotational constant, D_e: the equilibrium dissociation energy) have been investigated. The results of this work are in good agreement with the results available in literature. Moreover, for the first time, it was possible to study 20 new singlet and triplet electronic states of SrS molecule.

Keywords: strontium mono-sulfide, computational chemistry, *ab initio* calculation, potential energy curves, permanent dipole moment curves, spectroscopic constants

1. Introduction

In many areas of chemistry, the compound SrS, as all metal sulfides, is of great importance regarding the nature of the metal-sulfur bond. Corrosion processes, high temperature chemistry, and chemical vapor deposition are some examples of the significance of metal sulfide compounds (Halfen, Apponi, Thompsen, & Ziurys, 2001) (Bradley, 1989). Metal sulfides also play a role in biochemistry (Janczyk & Ziurys, 2006) where they are considered as sulfur-donating ligands in protein related reactions (Holm, Kennepohl & Solomon, 1996) (Halfen, Apponi, Thompsen, & Ziurys, 2001). Moreover, alkaline earth sulfide applications also exist in astrophysics (Takano, Yamamoto, & Saito, 1989) (Janczyk & Ziurys, 2006). Therefore, scientists are often interested in studying their properties.

Many alkaline-earth metal sulfides have been investigated experimentally and theoretically. However, studies conducted on the SrS molecule, unfortunately, remained few and constricted to only some low-lying electronic states (Marcano & Barrow, 1970) (Huber & Herzberg, 1979). For instance, a laser spectroscopy experiment was conducted, in 1988, on strontium sulfide, SrS, in order to obtain molecular constants, such as vibrational constants, rotational constants and bond lengths, with high accuracy and precision. The results were limited to 2 electronic states only, the ground state $X^1\Sigma^+$ and the first excited state $(2)^1\Sigma^+$ (Pianalto, Brazier, Obrien, & Bernath, 1988). Another experimental study, in 2001, allowed the recording of the bond length of SrS, for state $X^1\Sigma^+$, using millimeter/submillimeter-wave direct absorption methods (Halfen, Apponi, Thompsen, & Ziurys, 2001). Later, in 2010, experimental recordings were done on 4 isotopes of strontium mono-sulfide and the spectroscopic constants of the ground state $X^1\Sigma^+$ were obtained (Etchison & Cooke, 2010). Theoretically, this molecule has been studied by Partridge *et al.* using *ab initio* calculations. The study resulted in spectroscopic constants computed by 5 different calculation techniques (CASSCF: complete active space self-consistent field, CCI: contracted configuration interaction, CCI(4s4p): CCI with core correlation, MRCI: multi-reference configuration interaction, MRCI+Core: MRCI with core correlation) for three low-lying SrS electronic states: $X^1\Sigma^+$, $(1)^3\Pi$, and $(1)^1\Pi$ (Partridge, Langhoff, & Bauschlicher, 1988).

In the present work, the investigation of the ground state and several low-lying singlet and triplet electronic states of SrS, in the $^{2s+1}\Lambda^{\pm}$ representation, is done using multi-reference configuration interaction (MRCI with

Davidson correction) according to the *ab initio* computational method. Accordingly, the potential energy curves (PECs) of 24 electronic states and the permanent dipole moment curves (DMCs) of 19 electronic states are presented. The corresponding spectroscopic constants, such as the electronic energy with respect to the ground state (T_e), the harmonic frequency (ω_e), the internuclear distance at equilibrium (R_e), the rotational constant (B_e) and the dissociation energy (D_e), are also computed for 19 electronic states. Out of the 24 low-lying electronic states that are demonstrated in the current work, 20 new electronic states are studied here for the first time.

2. Computational Approach

Taking advantage of the graphical user interface GABEDIT (Allouche, 2010), the computational chemistry program MOLPRO (Werner, Knowles, Knizia, Manby, & Schütz, 2011) has been used in the current study to apply *ab initio* techniques to the strontium mono-sulfide compound. Using the state averaged complete active space self-consistent field (CASSCF) approach, the low-lying singlet and triplet electronic states of the diatomic molecule SrS have been studied by the method of multi-reference doubly and singly configuration interaction (MRDSCI) with Davidson correction (+Q). The strontium atom Sr, in its neutral state with 38 electrons, is treated with the energy-consistent effective core potential ECP28MWB basis (Kaupp, Schleyer, Stoll & Preuss, 1991), for *s, p* and *d* functions (*6s, 6p, 5d*)/[*4s, 4p, 2d*], where 28 electrons are considered in the core and the remaining 10 electrons are valence. As for the neutral sulfur atom S, its 16 electrons are distributed into 10 core electrons and 6 valence electrons using the ECP10MWB basis set (Bergner, Dolg, Kuechle, Stoll & Preuss, 1993) for s and p functions (*4s, 5p*)/[*2s, 3p*]. Both Wood-Boring (WB) effective core potential basis sets, ECP28MWB and ECP10MWB, represent a quasi-relativistic theoretical level of reference. Considering strontium mono-sulfide's 54 electrons, of which 38 electrons are for Sr and 16 electrons are for S, 38 electrons are made to belong to the core of the molecule (28 electrons from Sr and 10 electrons from S) and 16 electrons (the 10 valence electrons of Sr and the 6 valence electrons of S) are kept outside this core. The wave functions of these 16 out-of-core electrons are specified using 19 molecular active orbitals formed on *4s, 4p, 4d, 5s, 5p* and *6s* of strontium and *3s, 3p* and *4s* of sulfur. The later calculations are done by freezing 10 electrons in the *4s* and *4p* orbitals of Sr and in the *3s* orbital of S by keeping them doubly occupied, consequently leaving the explicit treatment to 6 valence electrons. As a result, the orbitals contained in the active space are 6σ (Sr: *5s, 4d_0, 5p_0, 6s*; S: *3p_0, 4s*), 3π (Sr: *4d_±1, 5p_±1*; S: *3p_±1*) and 1δ (Sr: *4d_±2*) distributed into the irreducible representations a_1, b_1, b_2 and a_2 as $3a_1$, $1b_1$, $1b_2$ and $0a_2$, denoted by [3, 1, 1, 0] in the C_{2v} point group symmetry.
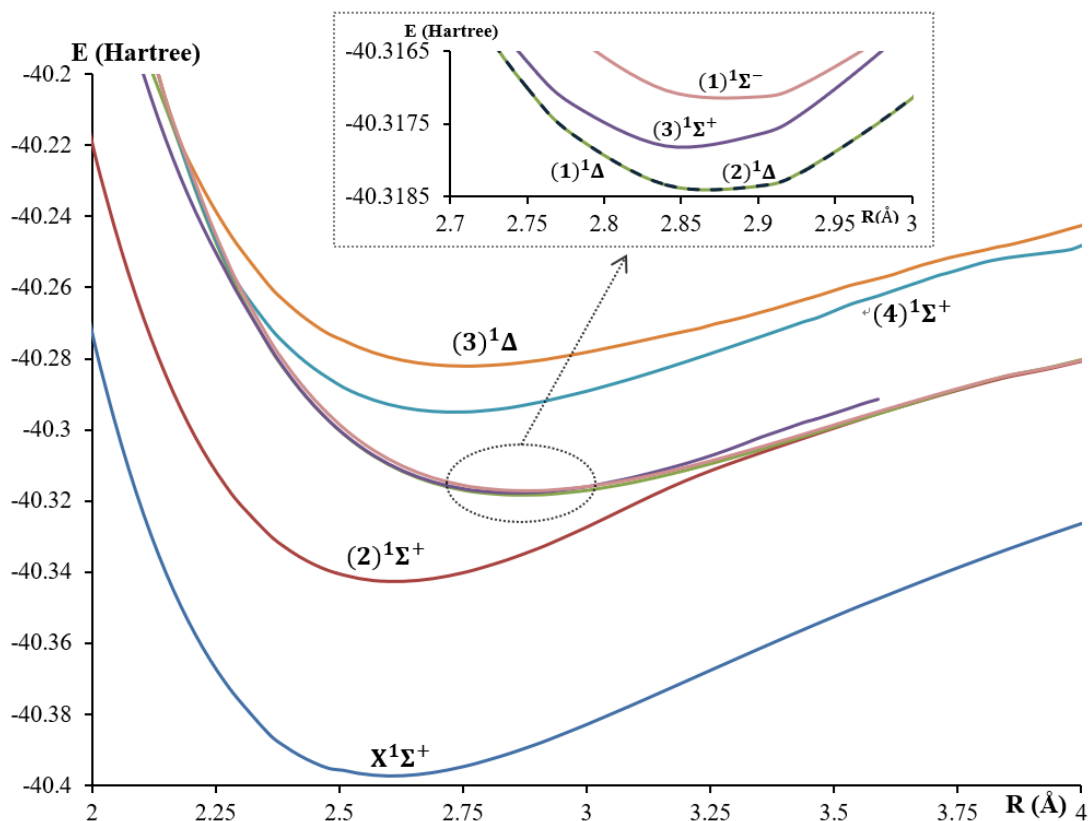
Figure 1. PECs of the singlet Σ and Δ electronic states of SrS

3. Results and Discussion

3.1 Potential Energy Curves and Spectroscopic Constants

In the range 2 Å ≤ R ≤ 4.01 Å, the potential energy curves (PECs), as a function of R, for the 24 singlet and triplet low-lying electronic states of the SrS molecule, in the $^{2s+1}\Lambda^{\pm}$ representation, have been calculated and presented for 77 internuclear distances (Figs. 1-5).

Figure 2. PECs of the singlet Π and Φ electronic states of SrS

Figure 3. PECs of the triplet Σ⁺ and some triplet Δ electronic states of SrS

Figure 4. PECs of some triplet Δ and Σ^- electronic states of SrS
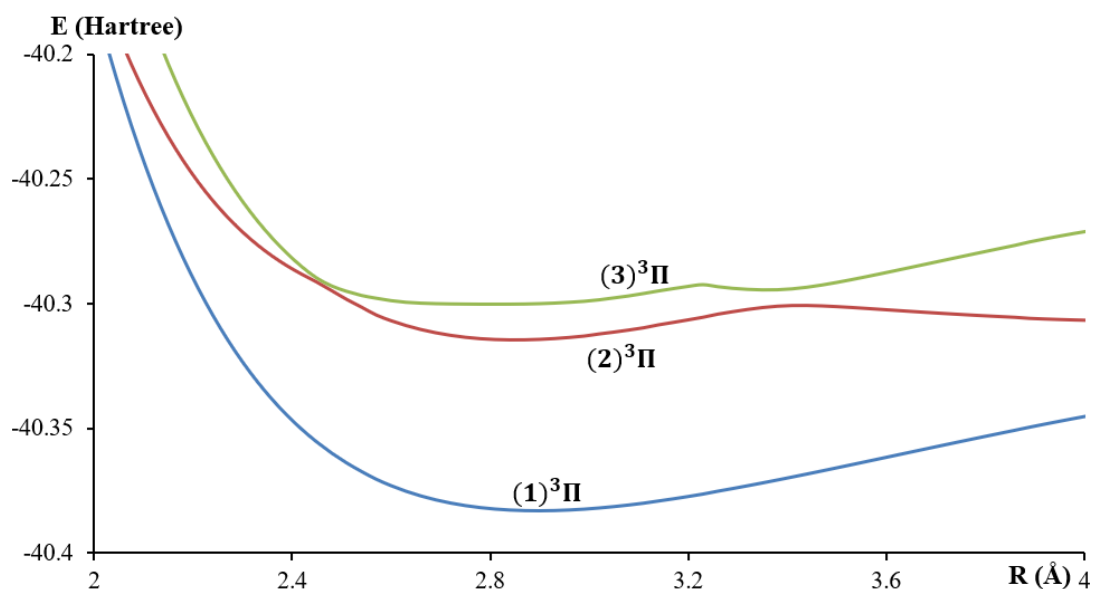
Figure 5. PECs of the triplet Π electronic states of SrS

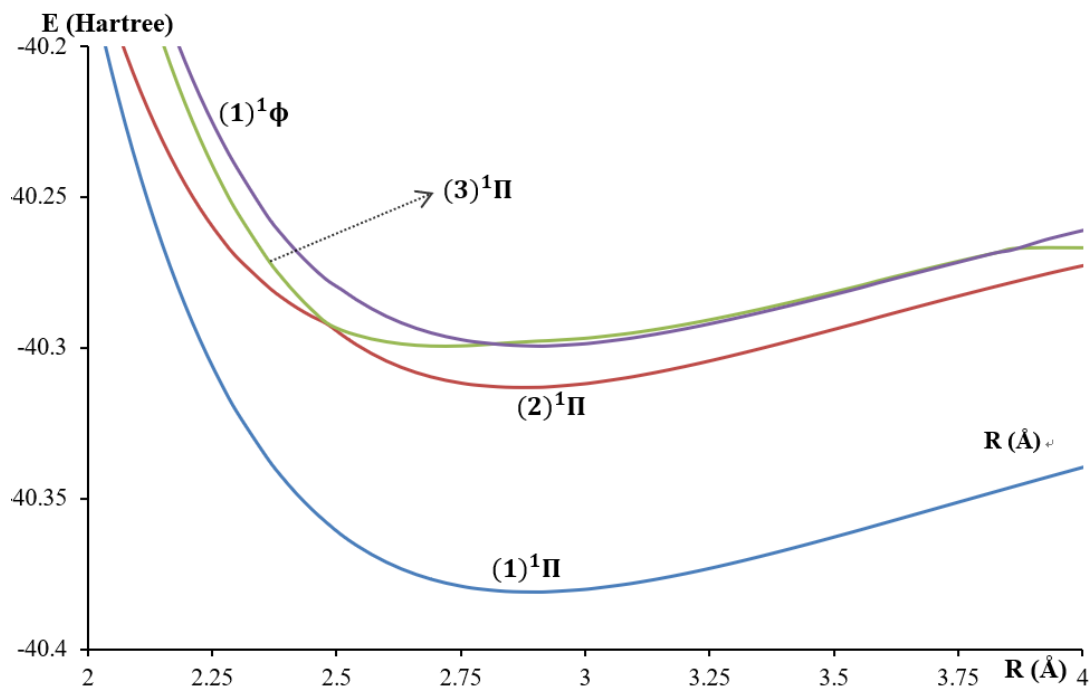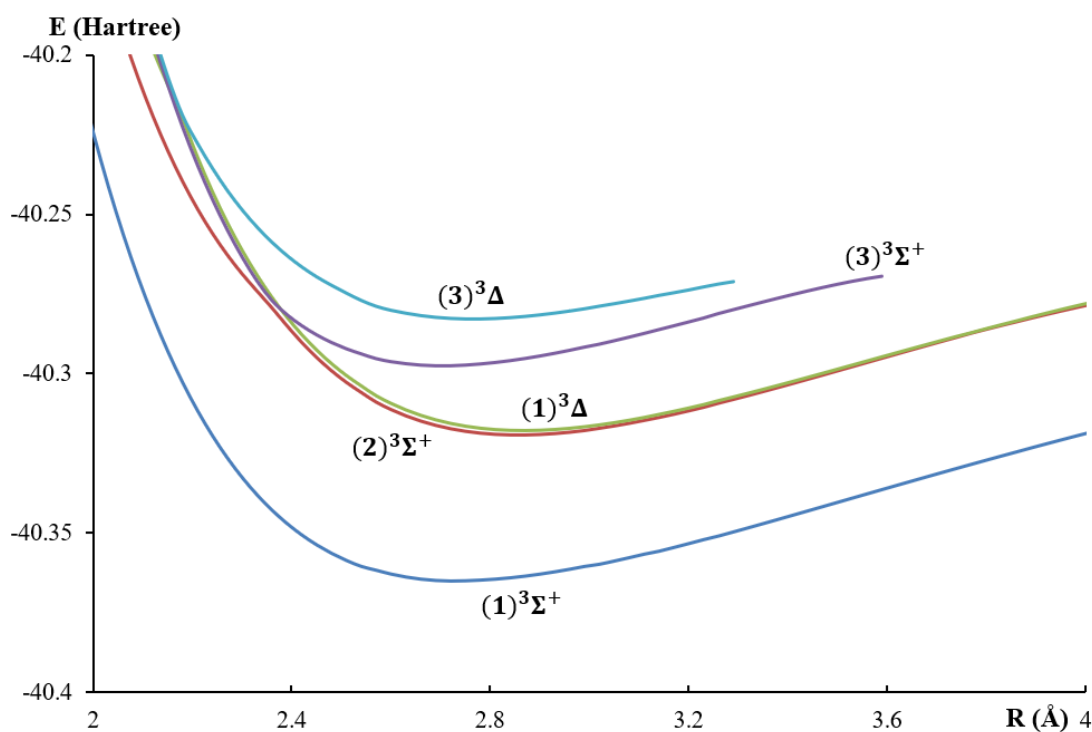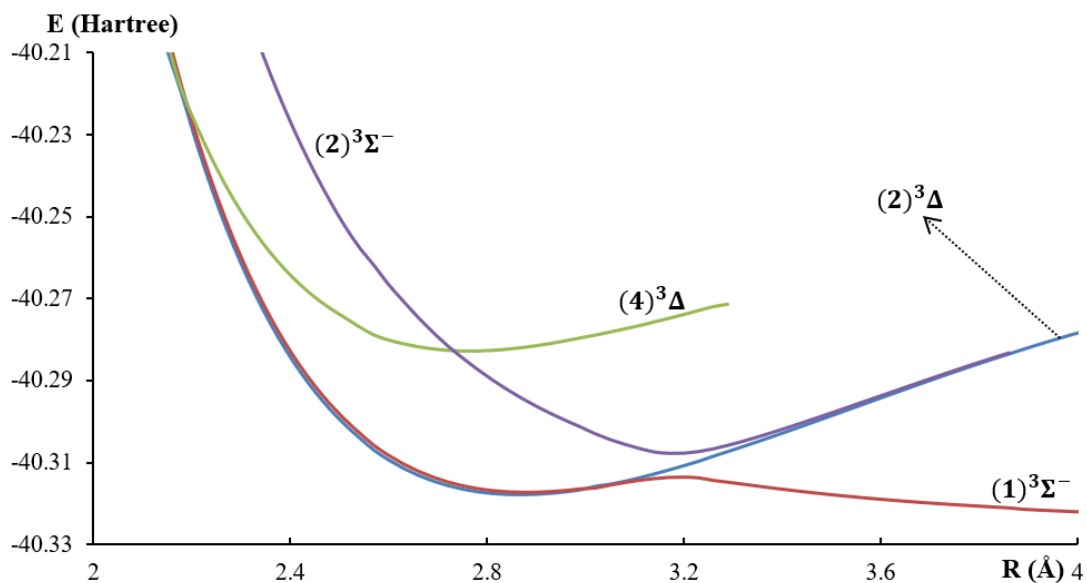By fitting the potential energy values into a polynomial in R around the internuclear distance at equilibrium, spectroscopic constants of SrS have been computed. The constants T_e (the electronic energy with respect to the ground state), ω_e (the harmonic vibrational frequency), R_e (the equilibrium internuclear distance), B_e (the rotational constant) and D_e (the equilibrium dissociation energy) have been obtained for 19 singlet and triplet SrS electronic states (Table 1). The spectroscopic constants of few other electronic states have not been calculated since the minima of their potential energy curves exist near locations of crossing or avoided-crossing between two states.

In order to study the effect of decreasing the core orbitals of the SrS molecule during the MRCI calculations, another MRDSCI computational trial has been applied to 2 states of SrS (using the same Sr and S basis sets mentioned earlier) by removing 1 of the closed-shell *s* orbitals from the core orbitals and the corresponding spectroscopic constants have been calculated (Table 1/[b]). One can notice that this trial has lead to promising results in comparison to previous experimental studies.

Table 1. Calculated spectroscopic constants for the singlet and triplet electronic states of the SrS molecule.

State	T_e (cm^{-1})	r_e (Å)	ω_e (cm^{-1})	B_e (cm^{-1})	$10^8 D_e$ (cm^{-1})
$X^1\Sigma^+$	0[a]	2.607[a]	269.3049[a]	0.105544[a]	6.54[a]
	0[b]	2.589[b]	312.0721[b]	0.107188[b]	5.01[b]
	0[c]	2.440[c]	388.38[c]	0.12072[c]	4.75[c]
	0[d,1]	2.484[d,1]	390[d,1]		
	0[d,2]	2.507[d,2]	363[d,2]		
	0[d,3]	2.458[d,3]	377[d,3]		
	0[e]	2.439[e]	388.2643[e]	0.120803[e]	4.87[e]
	0[f]	2.441[f]		0.120797[f]	4.67[f]
	0[g,1]	2.439[g,1]		0.120793[g,1]	4.67[g,1]
	0[g,2]	2.439[g,2]		0.121162[g,2]	4.70[g,2]
	0[g,3]	2.439[g,3]		0.121541[g,3]	4.73[g,3]
	0[g,4]	2.439[g,4]		0.115589[g,4]	4.28[g,4]
$(1)^1\Pi$	3522.03[a]	2.891[a]	231.7985[a]	0.085891[a]	4.71[a]
	7179[d,1]	2.751[d,1]	273[d,1]		
$(1)^3\Pi$	6548.01[a]	2.897[a]	227.2335[a]	0.085535[a]	4.84[a]
	9881[d,1]	2.788[d,1]	273[d,1]		
	5503[d,2]	2.807[d,2]	262[d,2]		
	5823[d,3]	2.749[d,3]	270[d,3]		
	6550[d,4]	2.808[d,4]	258[d,4]		
	6870[d,5]	2.748[d,5]	271[d,5]		
$(1)^3\Sigma^+$	10494.48[a]	2.733[a]	256.8097[a]	0.096122[a]	5.37[a]
$(2)^1\Sigma^+$	11937.50[a]	2.613[a]	304.3698[a]	0.105109[a]	5.01[a]
	11753.24[b]	2.613[b]	305.7439[b]	0.105091[b]	5.04[b]
	13932.70[e]	2.511[e]	339.1454[e]	0.113989[e]	6.16[e]
$(1)^1\Delta$	17262.06[a]	2.871[a]	234.3688[a]	0.087133[a]	4.81[a]
$(2)^1\Delta$	17262.38[a]	2.870[a]	234.3205[a]	0.087134[a]	4.82[a]
$(3)^1\Sigma^+$	17395.79[a]	2.857[a]	244.7969[a]	0.087986[a]	4.54[a]
$(1)^1\Sigma^-$	17540.41[a]	2.878[a]	232.2611[a]	0.086709[a]	4.83[a]
$(2)^1\Pi$	18444.97[a]	2.873[a]	234.6076[a]	0.086972[a]	4.78[a]
$(2)^3\Sigma^+$	20609.10[a]	2.858[a]	238.2755[a]	0.087915[a]	4.79[a]
$(1)^3\Sigma^-$	20862.41[a]	2.868[a]	236.8683[a]	0.087246[a]	4.75[a]
$(1)^3\Delta$	20862.98[a]	2.867[a]	236.7714[a]	0.087358[a]	4.75[a]
$(2)^3\Delta$	21031.22[a]	2.879[a]	224.0832[a]	0.086647[a]	5.13[a]
$(2)^3\Pi$	21635.23[a]	2.850[a]	249.6852[a]	0.088391[a]	4.40[a]
$(4)^1\Sigma^+$	22386.03[a]	2.736[a]	260.7516[a]	0.095836[a]	5.17[a]
$(3)^1\Delta$	25241.23[a]	2.756[a]	236.7732[a]	0.094536[a]	6.02[a]
$(3)^3\Sigma^+$	25323.85[a]	2.700[a]	266.1296[a]	0.098487[a]	5.36[a]
$(3)^3\Delta$	28562.08[a]	2.767[a]	208.6114[a]	0.093624[a]	7.76[a]

[a]Present work with all core orbitals during the CASSCF/MRDSCI calculation.

[b]Present work by decreasing the core orbitals by 1 during the CASSCF/MRDSCI calculation (for 2 states only).

[c]Experimental work by M. Marcano and R. F. Barrow (Marcano & Barrow, 1970).

[d]Theoretical work by Partridge *et al.* using 5 methods (d1: CASSCF, d2: CCI, d3: CCI (4s4p), d4: MRCI, d5: MRCI+Core) (Partridge, Langhoff, & Bauschlicher, 1988).

[e]Experimental work by Pianalto *et al.* (Pianalto, Brazier, Obrien, & Bernath, 1988).

[f]Experimental work by Halfen *et al.* (Halfen, Apponi, Thompsen, & Ziurys, 2001).

[g]Experimental work by K. C. Etchison for 4 SrS isotopes (g1:^{88}Sr^{32}S, g2:^{87}Sr^{32}S, g3:^{86}Sr^{32}S, g4:^{88}Sr^{34}S) (Etchison & Cooke, 2010).

In Table 1, the obtained results are compared to the results of the experimental and theoretical studies found in earlier literature (Marcano & Barrow, 1970) (Partridge, Langhoff, & Bauschlicher, 1988) (Pianalto, Brazier,

Obrien, & Bernath, 1988) (Halfen, Apponi, Thompsen, & Ziurys, 2001) (Etchison & Cooke, 2010). The spectroscopic constants in our study are generally in good agreement with the previous theoretical and experimental work. For instance, it is noticeable that the constants calculated here are very close to the CCI, MRCI and MRCI+Core theoretical outcomes of Partridge *et al.* (Table $1^{/d2, \, d4 \text{ and } d5}$) (Partridge, Langhoff, & Bauschlicher, 1988). As for the T_e values of the states $(1)^1\Pi$ and $(1)^3\Pi$ resulting from the CASSCF method used by Partridge *et al.*, they are remarkably higher than the results in the present study (Table $1^{/d1}$). This can be explained by the fact that the CASSCF method can be considered as a full CI computation in a restricted configurational space, which is sometimes problematic during the process of selecting configurations, whereas a multi-reference CI tends to result in more optimized calculations (Kohanoff, 2006).

Some sites of crossing and avoided-crossing between different electronic states of strontium mono-sulfide appear in the PECs (Fig. 1-5). For example, in Figure 1, each of the states $(1)^1\Delta$ and $(2)^1\Delta$ avoided crossing with the state $(3)^1\Delta$ at R=2.18Å while the state $(3)^1\Sigma^+$ avoided crossing with the state $(4)^1\Sigma^+$ at R=2.3Å. Figure 2 also shows avoided-crossing between states $(2)^1\Pi$ and $(3)^1\Pi$ at R=2.48Å and crossing between states $(1)^1\Phi$ and $(3)^1\Pi$ at R=2.84Å and R=3.92Å. Likewise, Figures 3-5 indicate avoided-crossing between electronic states as follows: $(2)^3\Sigma^+$ with $(3)^3\Sigma^+$ at R=2.36Å, $(1)^3\Delta$ with $(3)^3\Delta$ at R=2.18Å, $(2)^3\Delta$ with $(4)^3\Delta$ at R=2.18Å, $(1)^3\Sigma^-$ with $(2)^3\Sigma^-$ at R=3.2Å, and $(2)^3\Pi$ with $(3)^3\Pi$ at R=2.48Å and R=3.38Å. In Figures 3-5, crossings of electronic states appear in the following manner: $(3)^3\Sigma^+$ with $(1)^3\Delta$ at R=2.18Å and R=2.36Å, $(1)^3\Sigma^-$ with $(4)^3\Delta$ at R=2.18Å, $(2)^3\Sigma^-$ with $(4)^3\Delta$ at R=2.72Å, and $(1)^3\Sigma^-$ with $(2)^3\Delta$ at R=2.18Å and R=3.02Å.

3.2 Permanent Dipole Moment Curves

The permanent dipole moment curves (DMCs) have been obtained for the different electronic states of the molecule SrS (Fig. 6-10).
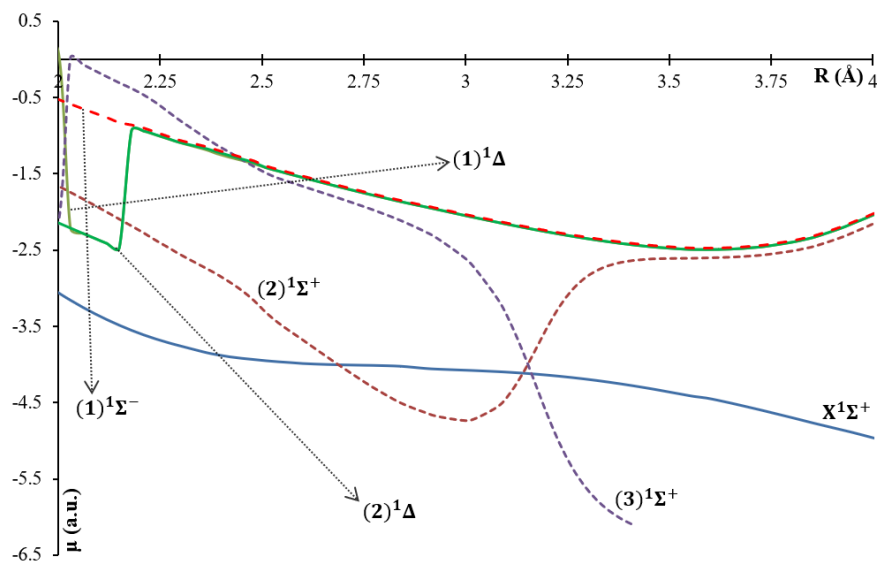

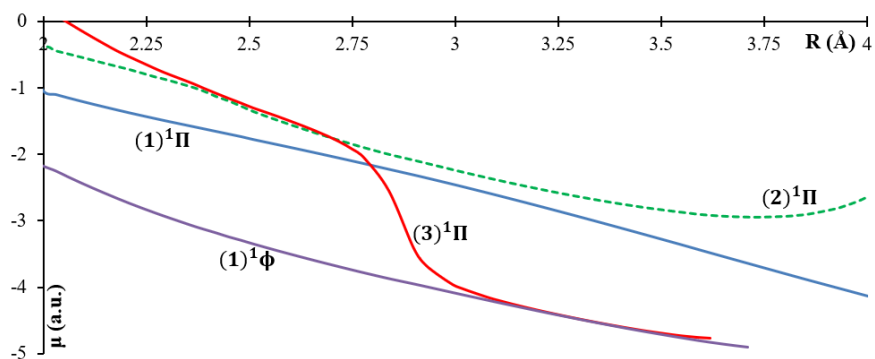Figure 6. DMCs of the singlet Σ and Δ electronic states of SrS

Figure 7. DMCs of the singlet Π and Φ electronic states of SrS
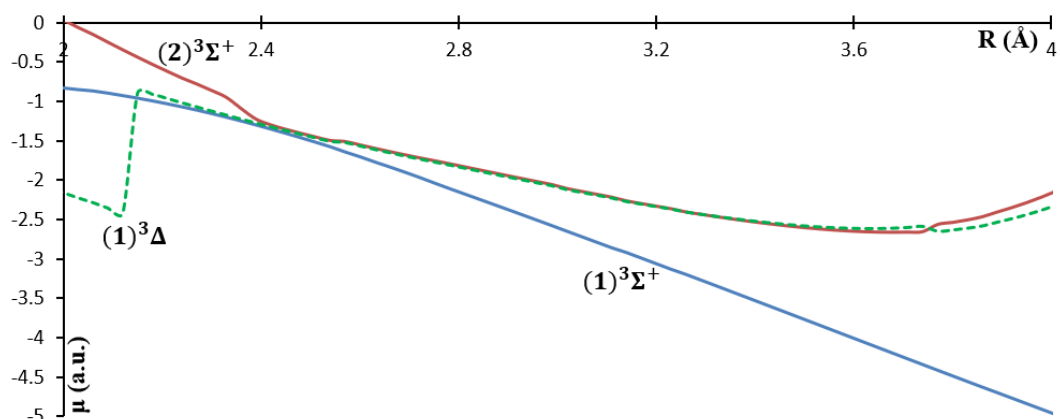
Figure 8. DMCs of some triplet Σ^+ and Δ electronic states of SrS
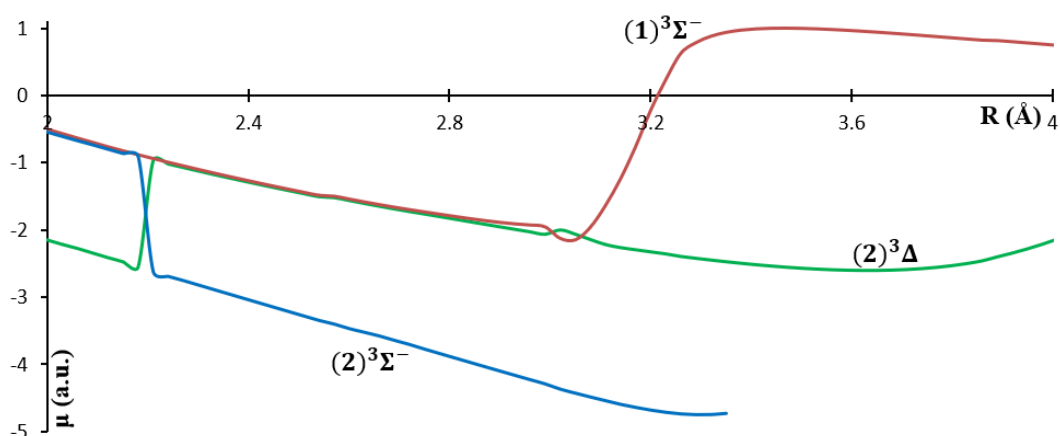
Figure 9. DMCs of some triplet Δ and Σ^- electronic states of SrS
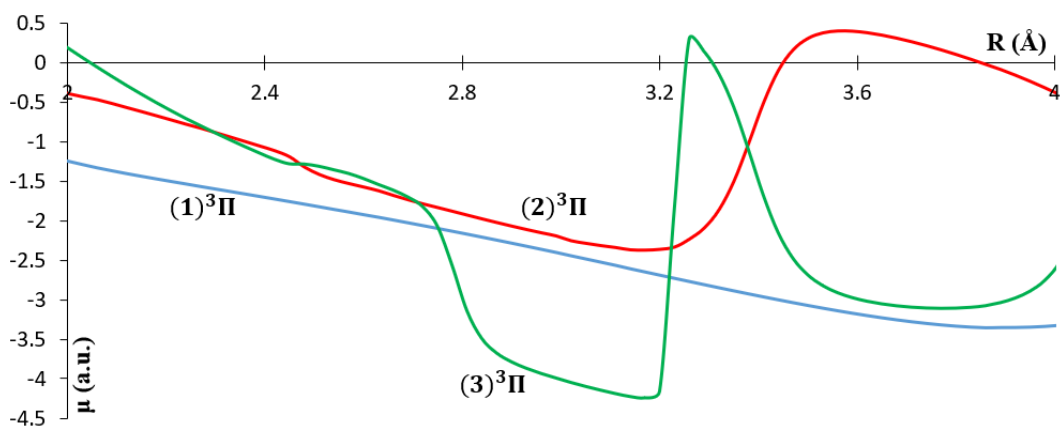
Figure 10. DMCs of the triplet Π electronic states of SrS

The permanent dipole moment μ_e is considered as one of the dependable physical properties (Steimle, 2000). It has been computed in this study by fixing the strontium atom (Sr) at the origin and by keeping the sulfur atom (S) free to move along the positive z-axis. Our calculations have been performed with the aid of the MOLPRO program (Werner, Knowles, Knizia, Manby, & Schütz, 2011). Usually, a reverse in the polarity of the atoms is reflected by a sharp change in the directions of the permanent DMCs. This occurs at positions of the internuclear distance (R) where avoided-crossing between electronic states exists in the potential energy curves (PECs). In the present work, one can notice that such sharp changes in the directions of our permanent dipole moment curves match very well with the R locations of avoided-crossing in PECs of SrS. This is an indication of the

good accuracy of the results presented in this study.

4. Conclusion

In the present work, 24 singlet and triplet electronic states of the strotium mono-sulfide molecule have been investigated using the *ab initio* computational method. The CASSCF/MRCI method applied to the SrS molecule, in the $^{2s+1}\Lambda^{\pm}$ representation, resulted in the calculation of the potential energy curves, the permanent dipole moment (μ_e) curves, the electronic energy with respect to the ground state (T_e), the harmonic frequency (ω_e), the rotational constant (B_e), the internuclear distance (R_e) and the dissociation energy (D_e). The current results generally show good agreement with the results available in literature. To the best of our knowledge, 20 new electronic states of SrS have been examined in this work for the first time. It should be noted that the new study, presented here, may aid in promising experimental investigations on the strontium mono-sulfide molecule in the future.

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Lean Bundles and Performance Outcomes in the Pharmaceutical Industry: Benchmarking a Jordanian Company and Operational Excellence International Project

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Abstract

This study benchmarks the implementation levels and performance outcomes of lean bundles of a Jordanian pharmaceutical manufacturing company with the results of the Operational Excellence (OPEX) model. The OPEX model is an ongoing international research project in the pharmaceutical industry. The results of the OPEX project were obtained, along with permission to use them in the present study. The same question items used in the OPEX project were used to prepare a questionnaire to collect data from the Jordanian pharmaceutical company. Fifteen managers from the Jordanian company with responsibilities related to lean management completed the questionnaire. The results demonstrated that the implementation levels of lean practices and the lean performance outcomes of the Jordanian pharmaceutical company varied in comparison to the OPEX project. The overall assessment showed that the Jordanian company is excellent in the total quality management bundle (at or above the levels of the benchmarked data), good in the human resource bundle (almost at the levels of the benchmarked data), acceptable in the just-in-time bundle (below the levels of the benchmarked data), and weak in the total preventive maintenance bundle (considerably below the levels of the benchmarked data). There are few benchmarking studies in the pharmaceutical industry in the area of lean management. In particular, this area is under-investigated in the developing world. The current study provides insights into the value of benchmarking key lean metrics against leading companies. This approach is expected to support pharmaceutical industry managers in the developing world to evaluate their current lean state, estimate the desired state based on the benchmarking results, and set appropriate strategies to promote lean management and operational excellence in their companies.

Keywords: lean management, lean bundles, lean operational performance, benchmarking, pharmaceutical industry, Jordan

1. Introduction

The pharmaceutical industry in the developing world faces many challenges, such as the pressures of rising costs coupled with low pricing policies from the authorities, along with strong competition in the markets. All these factors create the need to implement a system that can improve the company's performance and increase profits. In this context, lean management is seen as a key strategic option that can considerably improve the efficiency and effectiveness of pharmaceutical companies' operational processes, thus enhancing their competitiveness in today's globally competitive markets (Abdallah and Matsui, 2007; Phan et al., 2010; Al-Zu'bi et al., 2015; Shokri, 2017).

The pharmaceutical industry in Jordan started in the early 1960s. The industry concentrated on the production of generic drugs (patent-free medicines) and building quality into its products to have the potential for export. The industry was unable to attract foreign partnerships in its early stage due to the small size of the companies and the Jordanian population in comparison with Egypt, Syria, and Morocco (Global Research, 2007).

Today, there are 14 pharmaceutical manufacturing companies in Jordan that are active in the production of pharmaceuticals (JAPM, 2017). The pharmaceutical industry is considered to be a pioneer among the exporting sectors in Jordan; 81% of production capacity is designated for export to more than 60 countries (JAPM, 2017).

Per the Jordan Pharmaceutical Country Profile, published by Jordan's Ministry of Health in collaboration with the World Health Organization (WHO) in 2011, Jordanian pharmaceutical production capabilities are categorized into research and development for discovering new active substances, production of pharmaceutical starting materials (APIs), production of formulations from pharmaceutical starting material, and repackaging of finished dosage forms (WHO, 2011). The report further revealed that in 2008, domestic manufacturers held 33% of the market share according to the produced value.

Although lean management is widely implemented by manufacturing companies (Abu Nimeh et al., 2018; Abdallah et al., 2017; Abdallah and Matsui, 2009), it has been missed by many pharmaceutical companies in developing countries including Jordan (Shehadeh et al., 2016; Awad et al., 2016; Ayoub et al., 2017). Most of the pharmaceutical companies in the Middle East and North Africa (MENA) region focus on compliance with Current Good Manufacturing Practices (cGMP) guidelines while the operational performance of the manufacturing plants is overlooked. These companies mainly use financial performance measures, while operational measures are rarely used. Due to the scarcity of research on lean management and performance in the pharmaceutical industry in developing countries, it was necessary to initiate such research to address these shortcomings.

The driving force behind this study is the need to shed light on the concept of lean management in pharmaceutical companies in developing countries, especially in the MENA region, in order to provide the industry with a new tool to improve operations. These companies usually face problems of underutilization of capacity, low levels of technology, high scrap rates, insufficient product quality, and others (Bello-Pintado and Merino-Díaz-de-Cerio, 2013). In particular, the purpose of this study is to evaluate the levels of lean bundles and lean performance of a Jordanian pharmaceutical company. Next, the collected data is benchmarked with the results of the Operational Excellence (OPEX) model. The OPEX model is an ongoing international research project in the pharmaceutical industry in the area of lean management and operational performance, adopted from St. Gallen University, Switzerland, with permission to use its data and results. Finally, conclusions and recommendations will be derived based on the findings.

The remainder of this paper is structured as follows: section 2 presents the literature review. Section 3 presents research methodology. Section 4 presents results and discussion. Finally, section 5 presents conclusions, recommendations, and research limitations.

2. Literature Review

2.1 Lean Management

The term lean production was first used by Krafcik in 1988, as part of his study of the Toyota Production System (TPS) aimed at the elimination of waste (Krafcik, 1988). The holistic consideration of lean thinking and its principles have been successfully described by Womack et al. (1990) in the book The Machine that Changed the World. Later, a second book was published, entitled Lean Thinking, by Womack and Jones (1996). In this book, the authors defined the central practices which lead to lean management and provide recommendations for applying these practices in any organization.

The main principles of lean management are the identification of value for the customer, the elimination of waste, and the optimum generation of flow (Melton, 2005; Abdallah and Matsui, 2009; Saleh et al., 2017). Value definition refers to the idea that any manufacturing process is a way to deliver value to the customer, and any activity that does not add value to the customer is a waste (Womack and Jones, 1996). Waste is defined as "any human activity which absorbs resources but creates no value" (Ohno, 1988). Lean management strives to eliminate types of waste that include overproduction, waiting, transport, unnecessary motion, over-processing, defects, excessive inventory, and unused employee creativity (Liker, 2003). The optimum generation of flow refers to the idea that the production flow should be continuous, with no variation. The production line should not be stopped for machine breakdown, delay, or any other problem (Besterfield, 2014). Such lean principles might not be implemented, however, due to time constraints and concerns about the impact of such principles on regulatory compliance (Womack and Jones, 1996).

The literature dealing with lean practices indicates that different authors have different approaches to lean group concepts. For example, Womack et al. (1990) focused on the influence of specific aspects of lean management on manufacturing performance figures. Shah and Ward (2003) postulated four "bundles" of interrelated and internally consistent practices; they proposed just-in-time (JIT), total quality management (TQM), total preventive maintenance (TPM), and human resource management (HRM). Gebauer et al. (2009) concluded that JIT/continuous flow production, preventive maintenance, pull system/kanban, quick changeover techniques, cross-functional workforce, and continuous improvement programs are the most frequently included lean

practices. Azevedo et al. (2012) used the following lean practices in their study: supplier partnership, JIT, pull flow, quality management, and customer relationships. So and Sun (2010) measured lean management in terms of supplier selection, pull production, information technology, process focus, and employee empowerment. Tortorella et al. (2017) empirically validated four bundles of lean practices, namely, elimination of waste and continuous improvement, logistics management, top management commitment, and customer-supplier relationship management. Eriksson (2010) determined the following lean practices: waste reduction, process focus, continuous improvement, customer focus, systems perspective, and cooperative relationships.

This study adopts the approach proposed by Shah and Ward (2003). Accordingly, lean management is measured using four bundles: JIT, TQM, TPM, and HRM. These four bundles were selected to benchmark lean implementation of the Jordanian pharmaceutical company with the ongoing benchmarking project at St. Gallen University, which used this approach to measure lean management in the pharmaceutical industry.

2.2 Lean Operational Performance

Operational performance is defined as "the output or result achieved due to unique operational capabilities" (Tan et al., 2007). It usually refers to measurable outcomes of organizational processes, such as cycle time, inventory turns, and delivery (Neely et al., 1995). In this vein, operational performance is regarded as internal or process performance (Manikas and Terry, 2009). Flynn et al. (2010) pointed out that operational performance is related to internal improvements in a firm's response to a dynamic environment with regard to its competitors and customers. Lean operational performance refers to performance outcomes achieved as a result of applying lean principles. An organization that is operationally excellent through lean implementation leads its competitors by providing the lowest cost and the highest quality to its customers. It does this by performing the right tasks, at the right time, in the most efficient manner (Abdallah et al., 2009; Sharafat et al., 2016; Al-Sa'di et al., 2017).

Chen (2008) suggested that it is necessary to choose an appropriate range of performance measures, and these measures must be balanced to ensure that one performance or set of performance dimensions is not stressed to the detriment of others. Meanwhile, Gieskes et al. (1999) suggested that performance areas must be operationalized in a way that allows performance to be adequately measured against relevant performance indicators. It is necessary to find a comprehensive tool that can measure the overall lean operational performance of pharmaceutical companies. Benchmarking data are also important, especially with regard to limited published data about developing countries. Upon literature review, this study identified only a limited number of published works on lean practices and associated operational outcomes at pharmaceutical companies in the developing world. Shabaninejad et al. (2014) investigated the development of an integrated performance measurement model for the pharmaceutical industry in the Iranian market. They identified 25 key performance indicators; however, their suggested indicators were not presented as a comprehensive system to measure the overall lean performance of the company.

Friedli et al. (2013) adopted an operational performance model with their research group at the Institute of Technology Management at St. Gallen University. Their model had two distinctive elements: a technical sub-system and a social system. The technical sub-system consisted of the outputs of three lean bundles: TPM, TQM, and JIT. The social system included the outputs of an HRM bundle. Likewise, Bellm (2015) investigated lean operational performance in the pharmaceutical industry in emerging markets. The study used the quantitative data from the ongoing benchmarking project at St. Gallen University.

As the objective of this study is to benchmark lean bundles and lean operational performance of one Jordanian pharmaceutical company with the ongoing benchmarking project at St. Gallen University, lean operational performance indicators were adopted from the model proposed by St. Gallen University and its benchmark data. These lean operational performance indicators included items related to JIT performance, TQM performance, TPM performance, and HRM performance.

3. Research Methodology

3.1 Benchmarking Model Selection

The OPEX model was selected as a benchmarking model for this study. The model was adopted from an international research project in the pharmaceutical industry in the area of lean management and operational performance. The project was begun in 2004 at the Institute of Technology Management at the University of St. Gallen, Switzerland, and the Transfer Center for Technology Management at the University of St. Gallen, Switzerland (Friedli et al., 2013). The project provides participating firms the opportunity to position their plants against a broad range of pharmaceutical plants, to identify possibilities for improving lean operational performance (Gütter, 2014). Since 2008, pharmaceutical firms have been permitted to enter the continuous

benchmarking process at any time. The OPEX database includes more than 280 pharmaceutical plants from small and medium-sized companies (Bellm, 2015).

The OPEX benchmarking model includes lean enablers and outcomes. Enablers include lean bundles of JIT, TQM, TPM, and HRM. The outcomes reflect lean operational performance indicators related to JIT performance, TQM performance, TPM performance, and HRM performance (Gütter, 2014; Bellm, 2015).

Quantitative benchmarking data from OPEX was collected from Bellm (2015) and Friedli et al. (2013).

3.2 Measures

The survey items were adopted from the OPEX research project. In particular, the items were adopted from Bellm (2015) and Friedli et al. (2013). In the OPEX project, each lean bundle consists of several widely cited practices in the literature. Each practice was measured using several question items. The number of items to measure each practice ranged from 3 to 10. The JIT bundle included the practices of setup time reduction, pull production, layout optimization, and planning adherence. The TQM bundle included the practices of process management, cross-functional product development, customer integration, and supplier quality management. The TPM bundle included the practices of preventive maintenance, technology assessment and usage, and housekeeping. The HRM bundle included direction setting, management commitment and company culture, employee involvement and continuous improvement, and functional integration and qualification.

Respondents were asked to indicate the degree to which the provided statements apply to their plants, using a Likert scale of 1–5 where 1 indicated not at all and 5 indicated completely.

Lean operational performance was measured using key operational performance indicators adopted from the OPEX project. The indicators are related to JIT performance, TQM performance, TPM performance, and HRM performance. Table I summarizes lean operational performance indicators of each lean bundle and their respective definitions, as adopted from Bellm (2015), and the measurement unit of each indicator.

Table 1. Performance indicators of lean bundles

Lean bundle	Performance indicator	Definition	Unit
JIT	Cycle time	"Cycle time (from weighing to packaging). E.g. 30% of all products have a cycle time of 15-30 days. 70 % of all products have a cycle time of more than 30 days".	< 15 days 15-30 days > 30 days
	Service level (delivery)	"Perfect order fulfillment (percentage of orders shipped in time from your site (+/- days of the agreed shipment day) and in the right quantity (+/- 3% of the agreed quantity) and right quality) to your customer".	%
	Finished goods turns	"Annual cost of goods sold divided by the average finished goods inventory".	Number
	Raw material turns	"Annual cost of raw materials purchased divided by the average raw material inventory".	Number
TQM	Scrap rate	"Average difference between 100% and real achieved output in packaging operations".	%
	Complaint rate (supplier)	"Number of complaints as a percentage of all deliveries received (from your supplier)".	%
	Rejected batches	"Number of rejected batches as a percentage of all batches produced".	%
	Complaint rate (customer)	"Number of justified complaints as a percentage of all customer orders delivered".	%
HRM	Training	"Number of training days per employee (all kinds of training off and on the job".	days
	Unskilled employees	Number of unskilled employees as a percentage of all employees	%
	Absenteeism	Average number of absented days per employee per year	days
	Fluctuation	"Employees leaving per year your site due to terminations, expired	%

		work contracts, retirements etc. as a percentage of all employees."	
TPM	Dedicated equipment	"The percentage of your equipment that is dedicated to one product".	%
	Setup and cleaning	"The time spend for setup and cleaning as a percentage of the scheduled time".	%
	Unplanned maintenance	"Proportion of unplanned maintenance work as a percentage of the overall time spend for maintenance works".	%
	Overall equipment effectiveness	"OEE= (OEE) availability x (OEE) performance x (OEE) quality (OEE) availability = (Scheduled time – Downtime) / Scheduled time (OEE) Performance = (Amount produced x Lead cycle time) / Available time (OEE) Quality = (Inputs – Defects) / Inputs".	%

3.3 Data Collection

The data were collected from one Jordanian pharmaceutical company and were verified by site visits and observations at the manufacturing site. A questionnaire was prepared with constructs reflecting lean bundles and lean operational performance. The same question items used in the OPEX model were adopted for this study. The questionnaire was completed by fifteen managers, principal persons, and supervisors from various departments. In addition, interviews were conducted with the respondents to ensure that all the question items were understood and carefully answered. Respondents were encouraged to refer to the company's enterprise resource planning (ERP) system and various company units to ensure the accuracy of their responses whenever it was appropriate. The average response of the fifteen respondents was calculated for each question item and used later for benchmarking purposes.

The company selected for the survey is a local manufacturer and distributor of a broad range of pharmaceutical products. The manufacturing site has three main production plants, one for general products and the other two for cephalosporin and penicillin. The major production line at the company is solids, which represent 65.46% of the product portfolio, followed by semisolids at 26.54%, liquids at 6.16%, and sterile vials at 1.83%.

The company has a large production staff of more than 400 full-time employees working in eight-hour day shifts. The company has many export markets in the Middle East and some European countries. The company is referred to as Jordanian Pharmaceutical Company (JPC) throughout the paper.

3.4 Treatment of Data

As the results of the OPEX benchmark data are reported in percentages, the data collected from the JPC was also converted to percentages. For lean constructs, the implementation level was calculated as a percentage of each practice by taking the average value of the set from the 5-point Likert scale, dividing it by 5, and multiplying by 100. Most performance indicators were reported in percentages. In order to convert the remaining performance values into a percentage, each value was divided by its corresponding complete value in %; for example, to convert absenteeism (in days) into a percentage, the value was divided by 365 days and multiplied by 100 to generate a percentage.

The OPEX benchmark data regarding the implementation levels of the practices of lean bundles were split into four categories for comparison purposes with JPC: top 10 refers to the top ten companies from the advanced sample; advanced refers to companies in Europe, USA, Canada, and Japan; offshore refers to multinational companies operating in emerging markets; and domestic refers to local companies from developing countries.

With regard to lean operational performance indicators, an average value for the entire OPEX data set was calculated and labeled average industry, which was compared to JPC results.

4. Results and Discussion

4.1 Benchmarking JPC's Implementation Levels of Lean Practices with OPEX Data

Table 2 shows the comparison of the implementation levels of lean practices between JPC and other sites. JPC implementation levels varied among practices. Practices at JPC were higher than the top-10 sample in preventive maintenance, customer integration, and pull production; in supplier quality management, employee involvement, and functional integration, JPC was at the level of the advanced sites. JPC was lower than the benchmark data in the implementation of technology assessment, housekeeping, process management, cross-functional development, setup time reduction, layout optimization, and management commitment.

Table 2. Implementation levels of lean practices

Lean practices	JPC	Top-10	Advanced	Offshore	Domestic
JIT					
Setup time reduction	58%	69%	63%	60%	66%
Pull production	68%	62%	49%	47%	51%
Layout optimization	58%	73%	64%	63%	66%
Planning adherence	87%	76%	71%	71%	71%
TQM					
Process management	66%	73%	72%	72%	73%
Cross-functional product development	64%	76%	68%	73%	63%
Customer integration	75%	75%	73%	73%	73%
Supplier quality management	71%	75%	69%	69%	68%
TPM					
Preventive maintenance	81%	79%	75%	75%	75%
Technology assessment and usage	50%	64%	60%	60%	61%
Housekeeping	80%	87%	83%	84%	82%
HRM					
Direction setting	77%	88%	80%	83%	77%
Management commitment & company culture	65%	76%	73%	74%	72%
Employee involvement & continuous improvement	67%	71%	67%	70%	64%
Functional integration & qualification	68%	71%	66%	64%	67%

*Source of Table with major data except JPC data were obtained from St. Gallen University with Permission.

4.2 Benchmarking JPC's JIT Performance with Industry Average

The results in Figure 1 show that cycle time at JPC from weighting to packaging is 22.5 days, which is similar to the industry average of 22.7 days. This indicates well-optimized processes with the supply chain. However, JPC's performance in the aspects related to working capital was not as expected. In raw materials turns, JPC was only 2.4 while the OPEX average was about 8. In addition, the finished goods turns value at JPC was 3.9 turns per year compared to an average of about 16 for the industry.

JPC's performance at the service level (order fulfillment on time) was 97%, which was higher than the OPEX average value of 95%. This high service performance can be attributed to JPC's effective use of pull production; JPC's value was 68%, as shown in Table 2, which was higher than all the other sites. Interviews with managers at JPC revealed that the company adopts both a pull system and a push system simultaneously. They use the push system for the local market, while the pull system is used for the export markets. The company's policy in the local market is to maintain a sufficient stock of products; production for export is upon request from customers. However, the usage of both pull and push systems simultaneously seems to have an effect on raw materials and finished goods turns. In addition, JPC showed the worst result regarding set-up time reduction, as shown in Table II; this might also have had an effect on raw materials and finished goods turns.

4.3 Benchmarking JPC's TQM Performance with Industry Average

The results from JPC indicate high internal performance with regard to rejected batches; it was 0 at JPC, while it was about 1% for the OPEX industry average. The scrap rate at JPC of 3.5% was a bit higher than the OPEX average of 2.5%. Zero rejected batches at JPC can be attributed to the well-implemented cGMP requirements. JPC uses well-known cGMP systems, such as annual product quality review and trend analysis, to monitor all quality-related issues. Site visits at JPC revealed that the use of measurement methods, such as statistical process control, are poorly implemented. This may explain the high scrap rate compared to the OPEX average. This is supported by the extent to which the TQM practice of process management is implemented; process management includes the documentation, measurement, and improvement of processes. It was 7% lower at JPC compared to the top 10 sites, as shown in Table 2.
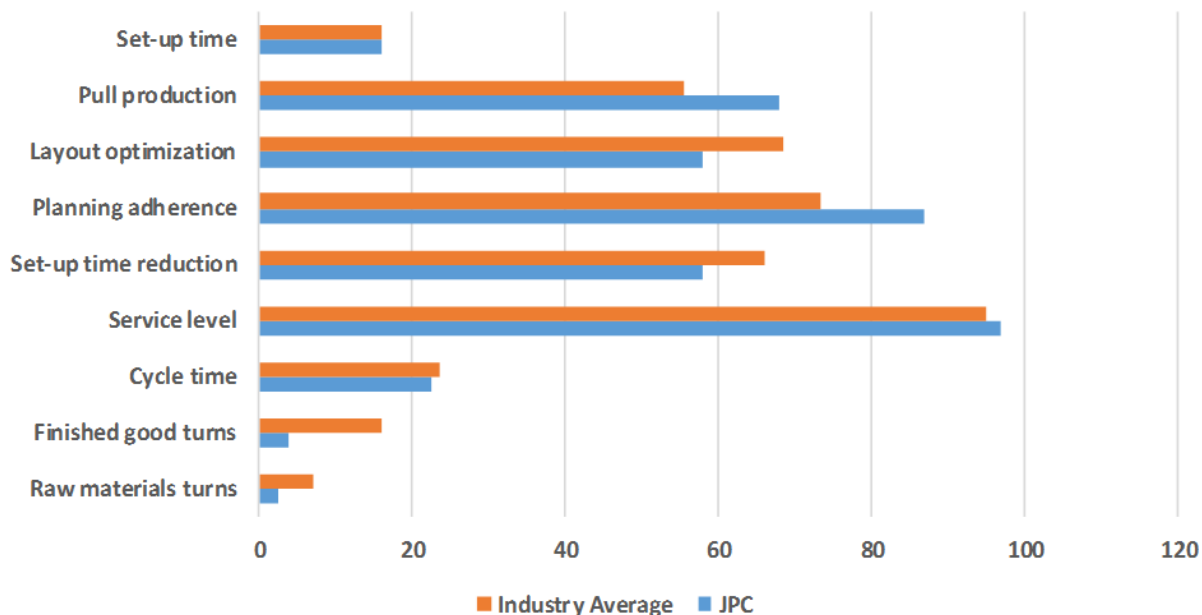
Figure 1. JIT implementation and performance at JPC compared to industry average

As for the indicators of external TQM performance, JPC showed similar high performance as the OPEX average, with regard to customer complaints (< 1%). In addition, supplier complaints were only slightly higher at JPC, with 4%, as compared to the OPEX average. The high external TQM performance results at JPC can be attributed to the extensive implementation of the TQM practices of supplier quality management and customer integration; the JPC levels of implementation are very close to top-10 companies, as shown in Table 2. Interviews with supply chain managers at JPC revealed that the company has 180 active suppliers (35% from India, 25% from Europe, 15% from the Middle East, 7% from China, and 18% from the rest of the world). The company applies a vendor qualification system, according to cGMP requirements. For example, to approve a supplier of active pharmaceutical ingredients (API), they require a GMP certificate for the manufacturer site and a drug master file (DMF) for the API; in addition, they perform the audit at the site.

Figure 2. TQM implementation and performance at JPC compared to industry average

4.4 Benchmarking JPC's HRM Performance with Industry Average

The performance indicators of the lean HRM bundle are shown in Figure 3. Absenteeism and fluctuation are used as measures of employee satisfaction (Bellm, 2015). Absenteeism, at 2.1%, was lower at JPC than the industry average value of 3.3%. In fact, the low absenteeism rate at JPC might be traced to strict roles in the pharmaceutical industry in Jordan, where absenteeism may lead to loss of employment. Fluctuation, however, was higher at JPC, at 13%, compared to the industry average of 7.5%. Fluctuation seems to have a greater

negative effect on the company, since knowledge can be lost when workers leave the company. In the Middle East region, there is a tendency for experienced workers to go work in the Gulf countries, where the salaries are much higher for the same position compared to Jordan. The generic pharmaceutical industry in that region is developing quickly, which is very attractive to Jordanian workers. Another reason for high fluctuation at JPC could be the lack of empowerment and qualification programs. Transferring authority from supervisors to line staff is not a common practice on the shop floor, as was observed from the site visits. Employees have limited authority to act on the problems they face during production, where a wrong decision could cost an employee his job. In fact, the degree of cross-trained employees was not high at JPC. It seems that the management at the company was not previously aware of the importance of job rotation and qualification programs; a newly implemented policy at the company is aimed at improving this weak point by providing more training and rotation.

Staff qualification, represented by the portion of unskilled employees as a percentage of the total number of employees, was similar to the OPEX industry average. However, the number of training days at JPC was 2.4 days, compared to the industry average of almost 17 days. This could be attributed to company culture at JPC. Site visits revealed that executive management believes there is no place for individual involvement in any changes that are not within the regulations, so they consider following rules and regulations more important than giving suggestions or employee involvement in improvement. They feel that giving the employees freedom to implement change would negatively affect compliance with regulations. It is therefore obvious that the direction of development, orders, decisions, and new projects flow from top management to employees without feedback from shop floor employees.
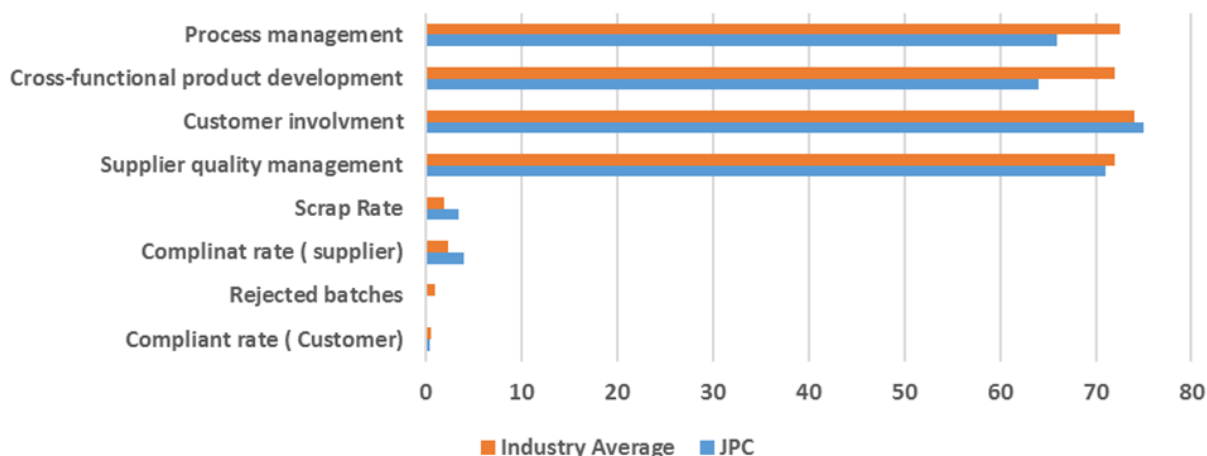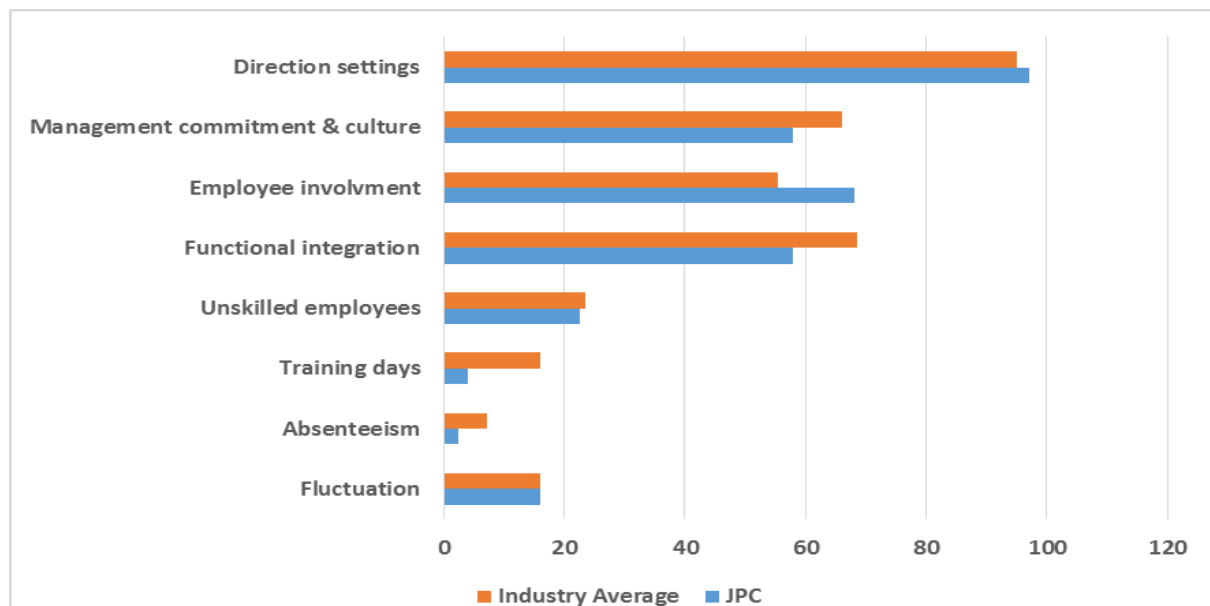

Figure 3. HRM implementation and performance at JPC compared to industry average

4.5 Benchmarking JPC's TPM Performance with Industry Average

The backbone of a manufacturing site is its production lines, which are dependent on machines. Thus, the main concern is to keep the machines running at full capacity during production time. Machine failure, lower production capacity, and low product quality are issues that have been addressed in depth in the literature as the results of poor production maintenance (Ahuja and Khamba, 2008; Abdallah, 2013).

Figure 4 shows the benchmarking results of TPM implementation practices and TPM performance at JPC compared with the industry average. The overall equipment effectiveness (OEE) level at JPC was 36%, which is less than the industry average of 51%. In addition, unplanned maintenance work at JPC represented 70% of its overall maintenance time. The percentage seems to be very high compared to 33% for the OPEX benchmark data. JPC visits and interviews with managers revealed that the company suffered from a lack of real preventive maintenance programs. This issue is currently undergoing improvement; the implementation level at JPC, at 81%, is higher than the top-10 sites (Table 2). Engineering management is serious about implementation of preventive maintenance programs and has already started training programs for production and maintenance staff, in

addition to the performance of full maintenance programs for the machines. They are also working on autonomous maintenance by empowering shop floor employees and machine operators. The new policy at the company is to shift from reactive to proactive maintenance. JPC is still lagging in the issues of utilization of equipment and minimizing downtime. The issue of OEE was still new to the company when they implemented a new program to measure it for all machines.

Dedicated equipment at JPC is only about 1%, while it represents about 36% of the OPEX benchmark data. The dedication of equipment to certain products reduces the need for changeovers and lowers the need for full cleaning validation between different batches after line clearance. This is evident from the TPM performance indicator of set up and cleaning, which represents 25% of schedule time at JPC as compared to the OPEX average of 15%. JPC's low percentage of dedicated equipment is explained by its large product portfolio, which comprises more than 200 formulations in 1554 different stock keeping units (SKUs). The level of dedicated equipment is closely linked to the type of pharmaceutical industry; in Jordan, it is mainly a generic industry.
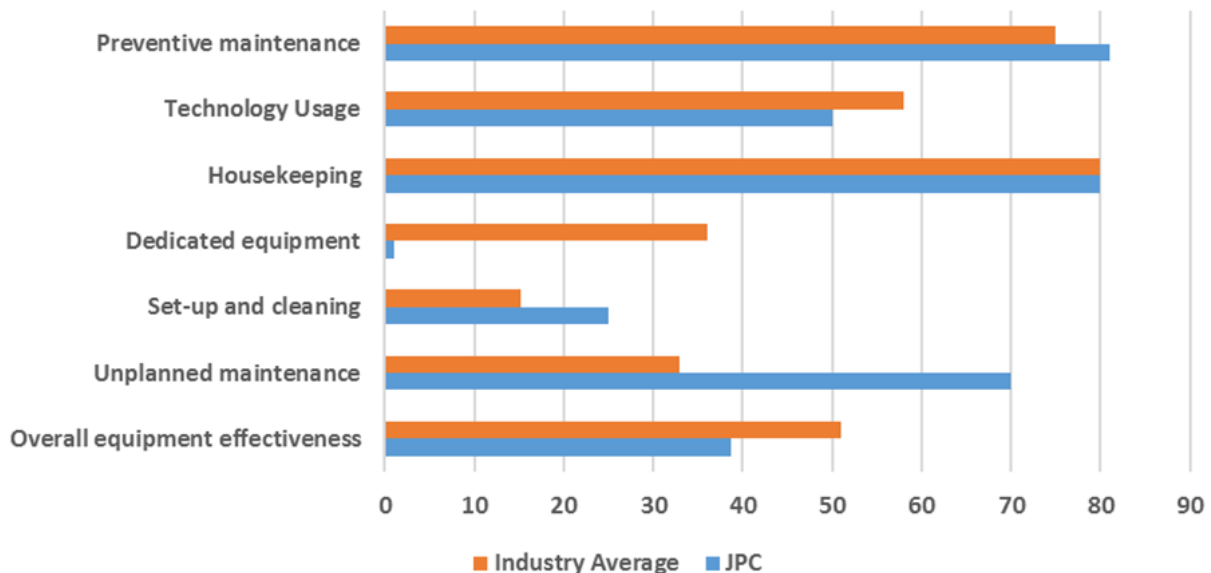

Figure 4. TPM implementation and performance at JPC compared to industry average

5. Conclusion, Recommendations, and Limitations

5.1 Conclusion

In this study, the extent to which lean practices have been implemented at one Jordanian pharmaceutical company were benchmarked with the results of the international research project in the pharmaceutical industry (OPEX). The adopted operational excellence (OPEX) benchmarking model provides a comprehensive methodology to evaluate the overall lean levels and performance of pharmaceutical manufacturing companies. The proposed model can assist pharmaceutical companies in emerging markets to evaluate their performance and develop appropriate implementation procedures for improving and enhancing operational effectiveness and efficiency. The model includes four lean bundles: JIT, TQM, TPM, and HRM. Each bundle was benchmarked in terms of the implementation levels of its main practices and the performance of the lean bundle.

The criteria shown in Table 3 were adopted in order to assess the implementation and performance levels at JPC compared to the benchmarked data.

The proposed criteria combine the implementation and performance levels of each lean bundle in order to make an overall assessment and rating of each bundle relative to the benchmarking data. The overall assessments are based on the results of JPC regarding the practices and performance indicators of each bundle compared with the benchmarking data reported in the previous sections. In addition, site visits to JPC by the authors and interviews with managers were taken into consideration to avoid misleading conclusions.

Table 3. Proposed criteria for rating JPC's results compared with the benchmarked data

Category of rating	Definition
Excellent	The implementation and performance levels of the lean bundle at JPC are at or above the levels of the benchmarked data.
Good	The implementation and performance levels of the lean bundle at JPC are almost at the levels of the benchmarked data.
Acceptable	The implementation and performance levels of the lean bundle at JPC are below the levels of the benchmarked data.
Weak	The implementation and performance levels of the lean bundle at JPC are considerably below the levels of the benchmarked data.

A careful assessment reveals a rating for JPC that is close to excellent for the TQM bundle. The implementation of TQM practices at JPC was excellent with regard to customer integration and supplier quality management. Process management and cross-functional product development showed levels ranging between good and acceptable. Likewise, the TQM performance was excellent, especially given the 0% of rejected batches and customer complaint rate. In addition, good performance results were shown with regard to scrap rate and supplier complaint rate.

The overall assessment of the HRM bundle reveals a rating close to good. The implementation level of the HRM practice of functional integration was excellent. Employee involvement showed a good implementation level. The practices of direction setting and management commitment showed acceptable implementation levels. HRM performance indicators showed excellent ratings regarding three indicators: unskilled employees, absenteeism, and fluctuation. However, JPC showed a weak rating regarding training days.

The overall rating of the JIT bundle is close to acceptable. The implementation levels of the JIT practices of pull production and planning adherence at JPC were excellent. However, the two other practices, setup time reduction and layout optimization, showed acceptable implementation levels. As for JIT performance, JPC showed excellent performance concerning delivery service level and good performance concerning cycle time. Nevertheless, JPC showed weak performance with regard to finished goods turns and raw materials turns.

Regarding the TPM bundle, the overall assessment of JPC tended to be weak. Although the implementation level of TPM practice of preventive maintenance was excellent, the levels of technology assessment and housekeeping were weak and acceptable, respectively. TPM performance showed an excellent rating regarding setup and cleaning. However, performance indicators of dedicated equipment, unplanned maintenance, and OEE showed weak ratings at JPC. Figure 5 summarizes the overall rating of each lean bundle.

Figure 5. Overall rating of implementation levels and performance of lean bundles at JPC

5.2 Recommendations

With regard to TQM, it is recommended that JPC management maintain customer complaints at a low level while keeping rejected batches to zero. In addition, improvement plans are needed to reduce supplier complaints and scrap rates. With regard to JIT, it is recommended that JPC continue working on reducing cycle and setup times. In addition, considerable improvements are needed to improve performance metrics on raw material and finished product turns. With regard to HRM, JPC management should make an effort to diffuse the strategic direction company-wide, to positively influence the organizational culture and reflect management's commitment to lean philosophy. Training represents one major weakness at JPC; it should be given priority, as it promotes cross-functional teams and provides the basis for real improvements. Likewise, emphasis should be

given to reducing fluctuation and increasing employee involvement. With regard to TPM, there is plenty of room for improvement by enhancing preventive maintenance programs while initiating OEE monitoring, reducing unplanned maintenance, improving housekeeping, and increasing the qualification of the maintenance staff through training.

5.3 Managerial Implications

The pharmaceutical industry, like other industries, faces challenges associated with severe global competition and pressure to improve quality while reducing cost. This situation is even more evident in developing countries, where many companies struggle to sustain their market shares and improve the efficiency and effectiveness of their operations. While lean management has grown in popularity in the pharmaceutical industry in developed countries, it is still a new concept in developing countries. Managers must consider lean management as an effective competitive strategy for achieving operational excellence. Benchmarking the levels and performance outcomes of lean bundles with leading international companies enables companies in the developing world to assess their success and determine areas that should be targeted for improvement. The current benchmarking study of the pharmaceutical manufacturing company in Jordan provides insights regarding the usefulness of comparing key lean metrics against leading companies. This new approach to the pharmaceutical industry in developing countries can support senior management in adopting appropriate strategic plans to promote lean management and operational excellence in their companies. In addition, the data presented in this study represent essential information in this field that can be utilized by companies to implement a lean program and steer themselves toward operational excellence, regardless of the region in which the manufacturing site is located.

5.4 Limitations

This study was applied to only a single pharmaceutical company in Jordan. This was due to the familiarity of this company with lean management; in addition, other companies declined to participate. Future studies are needed in developing countries with an appropriate sample size of pharmaceutical companies to obtain more generalizable results regarding lean management and enable investigation of causal relationships. Finally, only fifteen responses were received from JPC. This small number is inappropriate for performing validity and reliability analysis of the constructs. Future studies with an appropriate sample size will avoid this limitation.

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Evaluation of Road Infrastructure Alternatives Through a Saving Gradient in Travel Times. Case Study: Second Connection Villamaría-Manizales, Colombia

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Abstract

In the last century, the migration of people from rural to urban areas of cities has generated a set of dynamics in different sectors such as social, economic, educational that have led cities to collaborate among them, generating a constant synergy in order to obtain a sustained development in multiple aspects. In this sense, Manizales as the capital of the department of Caldas in Colombia has generated a conurbation with the nearest neighboring municipality, Villamaría reaching a combined population of 419 943. Although this synergy has taken place for several decades, these municipalities only have a place of connection, because they are separated by a geographical barrier, the Chinchiná River. This connection has had clear connection problems, due to the high flow of vehicles that move between both municipalities, so it is essential to project a second connection, to further boost mobility among its inhabitants. For this reason, in this research four (4) alternatives of connection are proposed, according to the suggestions of the Manizales 2017 Mobility Master Plan, through the calculation of the global average accessibility and the quantification of the gradient of savings generated in the average times of trip, based on the current situation of both cities. The results show which is the alternative that benefits population the most in terms of travel time savings, although three of them generate considerable savings and only one is discarded because it benefits a smaller number of inhabitants in very low percentages of savings compared to the others. The evaluation of infrastructure alternatives through the gradient of savings in travel times is useful to determine the best options in the pre-feasibility phase of investment projects in the transport area.

Keywords: Alternative evaluation, case study, global mean accessibility, road infrastructure network, saving gradient, pre-feasibility

1. Introduction

In recent decades, cities around the world have chosen to use transport models to justify investments in the area of mobility such as new roads, bridges, connections and interchanges as well as the implementation of new public transport systems such as metro , cable, BRT or trams, because these demand a large monetary, fiscal, political and time investment, from its planning and construction to its implementation (Marvin & Guy, 1999; Ortúzar & Willumsen, 1994; Te Brömmelstroet & Bertolini, 2011). In this sense, supply models such as accessibility seek to quantify the supply of transport and equipment in order to find a current scenario and thus make better decisions based on the greatest benefit for the population. On the other hand, the different governmental institutions have adopted different methodologies, seeking to organize their planning in the best way. In Colombia, through the law 338 of 1997, the elaboration of Territorial Planning Plans (POT) was regulated, in the field of urbanism, which functions as a tool for planning and ordering the territory, determining rules in various areas such as the uses of soil, environment, and construction, among others. These have different scopes, depending on the number of

inhabitants of the city or municipality and have a validity of up to twelve (12) years (Congress of the Republic of Colombia, 1997). Also, through the law 1 083 of 2006, the various actions that cities should follow in the field of urban mobility in search of sustainability in transport were determined, prioritizing alternative modes of transport such as bicycle and public transport, as well as the passage to cleaner technologies in vehicles such as electricity. Through the Urban Mobility Plans, which have a diagnosis of the current situation of the city and formulate actions and projects in the short, medium and long term in order to achieve the objectives of better urban mobility (Congress of the Republic from Colombia, 2006).
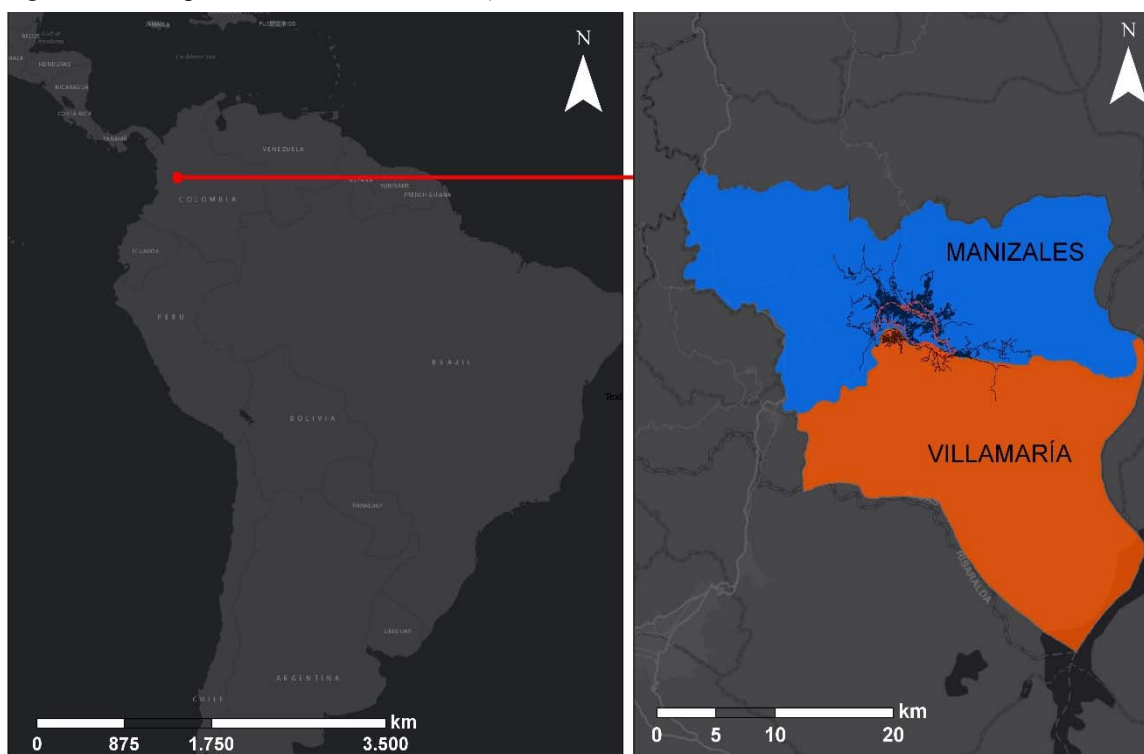

Figure 1. Study Zone Georrefernencing

With respect to this, Manizales, capital of the department of Caldas in Colombia (Blue in figure 1) developed, formulated and approved the Land Management Plan 2017 – 2031 (Mayoralty Manizales, 2017a) and the Mobility Master Plan 2017 – 2032 -MMP (Mayoralty of Manizales, 2017c, 2017b). According to the latter, Manizales travels (982 231 daily trips) has a large percentage of people who walk (29%) and public transport (24%), which has flexible offers such as the bus, small buses, aerial tramway and collective mini buses, although the latter has seen its demand decreased in alarming numbers throughout the country (Cardona, Escobar, & Moncada, 2017), moving to the private vehicle (25%) whose motorization rate of cars and motorcycles has been increasing, what will make the road network unsustainable in the coming decades (Manizales Como Vamos, 2017) multiplying the importance of actions such as those proposed in the PPM through the 138 projects developed along 6 pillars such as the empowerment of free space for pedestrian transit, the use of bicycles and the development of the Strategic Public Transport System- SETP, among others. Among these projects, the various proposals made in the formulation of the MMP for a second road access to the municipality of Villamaría (Orange in Figure 1), since it is the only connection that is currently enabled, has constant congestion problems, that produce an increase in travel times affecting the multiple trips that for different reasons are made between the two municipalities that together form a conurbation of approximately 419 000 inhabitants for 2017 (DANE, 2010), which operates jointly (Mayoralty of Manizales , 2017b). The MMP proposes three tentative points for the new connection (see figure 2) although these are not evaluated by any known methodology, so in this investigation an evaluation of the second access to Villamaría will be made in the three proposed points (Two alternatives in the West and one in the North and one in the East in the municipality of Villamaría) through models of global average accessibility, which are transport supply models, which measure the benefit generated by new infrastructure works in the road network in terms of savings in the average travel time of the inhabitants (Moncada, Cardona, & Escobar, 2018).
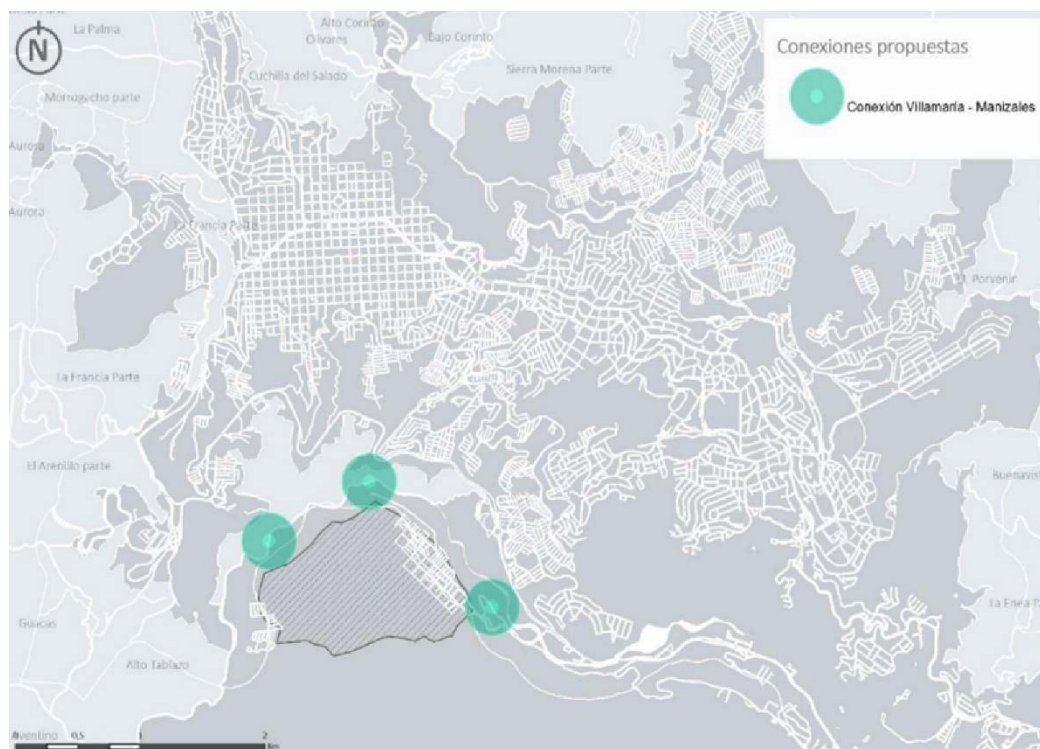
Figure 2. Alternative location for second conection Villamaria-Manizales (Mayoralty of Manizales, 2018b)

The global average accessibility is a model of transport offer that measures the connection between all the nodes of the road network by analyzing the minimum routes among them, obtaining the travel time matrix (Escobar & García, 2012). This concept has evolved, since Hansen (1959) defined it as "... the potential opportunities for interaction ...", deriving in multiple approaches (Ingram, 1971) and types of measurement (Pirie, 1979). In addition, over the years, various researchers have made revisions of this concept (Dalvi & Martin, 1976; Geurs & Ritseman Van Eck, 2001; Geurs & van Wee, 2004; Koenig, 1980; Morris, Dumble, & Wigan, 1979), also defining the future focus and the different challenges it confronts in the field of research and urban planning (Geurs, De Montis, & Reggiani, 2015; van Wee, 2016). On the other hand, it was Weibull who in 1976 defined accessibility as the physical proximity between two geographical points and proposed the main axioms that must be met to make an accurate calculation of the measure, supplemented by Miller (1999) years later. Furthermore, global average accessibility is a measure based on infrastructure, according to the perspectives adopted by Geurs and Ritsema van Eck (2001), since it uses the road infrastructure network and its average speeds as a fundamental input for the calculation (Moncada et al., 2018). In Manizales and the central region of Colombia, this type of measure has been used for similar investigations in the field of road infrastructure (Perilla, Cardona, & Escobar, 2018) and prioritization of road projects (Escobar & García, 2012), analysis of metropolitan areas (Escobar, Cardona, & Moncada, 2018a), recovery charging (Escobar, Cardona, & Moncada, 2018b), road concession analysis (Muñoz-Espinosa, 2016), among others.

Next, the research methodology applied in this article will be described and then the main results will be listed together with their respective discussion to finally frame the obtained conclusions.

2. Methodology

Figure 3 shows the flow diagram of the methodology applied in research. In the following items, each of the stages is described in detail.

2.1 Validation of the Road Infrastructure Network and Construction of the Different Study Scenarios

In the first instance, the validation of the road infrastructure network is made in the current situation. This must comply with the theory of graphs, which has been used in multiple applications in the area of transport, primarily for the representation of road infrastructure networks (Derrible & Kennedy, 2009, Duarte, Becerra, & Niño, 2008). This theory considers that a graph (G) is composed of vertices (V) (called nodes in transport networks) and edges (E) (arcs in transport networks), where each edge is formed by a pair of vertices (Deo, 1974). This network was

built for the construction of the PPMM of 2011 using tools of Geographic Information Systems (GIS) and has been constantly updated for more recent research (Escobar, Montoya, & Moncada, 2018; Moncada et al., 2018; Montoya & Escobar, 2017; Perilla et al., 2018).
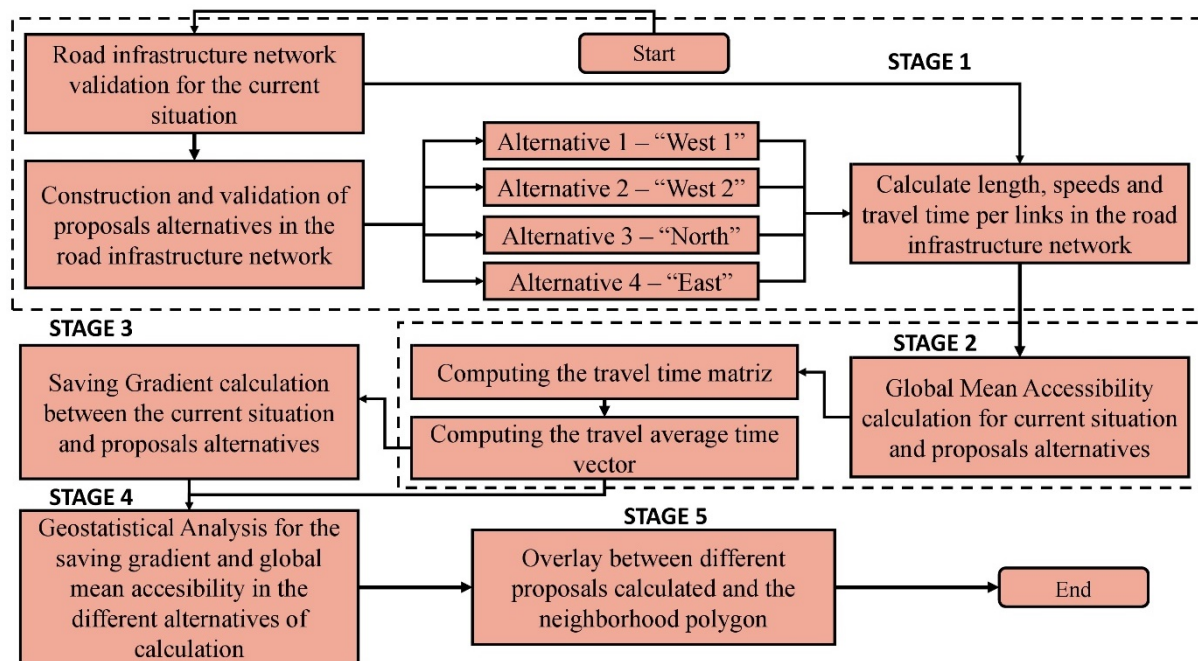

Figure 3. Investigation methodology

In the second instance, the construction of four (4) proposed scenarios for the second connection between Villamaría and Manizales takes place, taking into account the places marked by the MMP of 2017 (see figure 2).

Finally, in the current scenario and each proposed scenario, the travel times (tvi) must be calculated for each arc, taking into account the length (li) of each arc obtained by means of GIS tools and the speed (Vi), which It was computed thanks to global positioning systems (GPS), placed in different vehicles that crossed the road infrastructure network (Escobar & García, 2012). For the proposed new routes, an average speed of 45 km / h is defined for all the arcs.

2.2 Calculation of Global Average Accessibility, Current Situation and Proposed Scenarios

For each of the proposed scenarios (4) as well as for the current situation, the global average accessibility is calculated. For this, the TRANSCAD 7.0 software is used, which is a GIS software that has specialized complements in the transport field. First, the travel time matrix must be calculated between all the nodes that make up the road infrastructure network. This calculation is made using the Dijkstra algorithm of minimum roads (Dijkstra, 1959; Sanders & Schultes, 2007), which optimizes the travel time between the different nodes taking into account the global penalty for the road infrastructure network, calculated by an empirical method in 0.58 minutes on the left and 0.49 minutes on the right. After obtaining the travel time matrix for each scenario, we proceed to calculate the average travel time vector $(\overline{Tvi})$, by means of equation (1), which takes into account the sum of travel time between the origin (i) and destination (j) node pairs and the total number of nodes to which the network can travel (n-1) (Escobar et al., 2018a, Moncada et al., 2018). Also, this vector of average travel times must be related to the geographical coordinates of each node in order to perform the statistical analysis in later stages.

$$\overline{Tvij} = \frac{\sum_{j=1}^{n} tv_{ij}}{n-1}$$

(1)

2.3 Saving Gradient Vector Calculation

In this instance of the investigation, the calculation of the saving gradient vector $\left(V_{sg}(\%)\right)$ is performed,

comparing the current global average accessibility situation with the four (4) proposed second connection scenarios between Villamaria and Manizales. For this, the equation 2 is used, where $\overline{Tv_{cs}}$ corresponds to the average travel time vector of the current situation and $\overline{Tv_{ps}}$ corresponds to the average travel time vector of the proposed scenarios (Moncada et al., 2018; Perilla et al., 2018). In this case, four savings gradient vectors are calculated, corresponding to the percentage saved at travel times with respect to the current situation generated by the new connection alternatives between Villamaría and Manizales.

$$V_{sg}(\%) = \left(\frac{\overline{Tv_{cs}} - \overline{Tv_{psi}}}{\overline{Tv_{cs}}} \right) * 100 \quad i = 1,2,3,4. \tag{2}$$

2.4 Construction of Isochrones Curves of Global Average Accessibility and Savings Gradient

For the construction of the isochrones curves of global average accessibility and gradient savings, for the current situation and the different analyzed scenarios, the ordinary Kriging geo-statistical model is used, with a linear semi-variogram as a structural equation (Díaz Viera, 2002; Oliver & Webster, 1990), which has been used in various investigations on issues related to transport (Escobar et al., 2018a, Lindner, Pitombo, Rocha, & Quintanilha, 2016; Zhang & Wang, 2014). In this case, the average time travel vectors are used as interpolation input, in the case of the global average accessibility and the savings gradient vectors, in the case of the savings gradient.

2.5 Analysis of the Covered Population

Finally, an analysis of population coverage is made by means of the isochrones curves of global average accessibility and savings gradient along with the neighborhood polygon of the city of Manizales and Villamaría (Moncada et al., 2018), which has information regarding the population living in each of the neighborhoods and their average socioeconomic stratum, which is a differential housing measure between 1 (low) and 6 (high), where the urban characteristic, and socio-economic variables are taken into account (Perilla et al., 2018). This will allow us to obtain the ogive percentage of population covered in the case of the global average accessibility and the "Elbow" graph of savings coverage in the case of the savings gradient (Moncada et al., 2018, Perilla et al., 2018).

3. Results and Discussion

3.1 Infrastructure Road Network, Current Situation and Proposed Scenarios

In the upper left of figure 4 we can see the road infrastructure network of the city of Manizales and Villamaría, which has about 682 km of roads dedicated to vehicles. In the current situation, the connection between Villamaría and Manizales has a double lane road that is incorporated by means of a tunnel to the Pan-American highway, a few hundred meters from the transport terminal of the city, this connection, being unique, has high traffic congestion which will cause a collapse in mobility between these two conurbations in the coming years (Mayoralty of Manizales, 2017b). As for the alternatives for the second connection, the MMP pointed to three different places (see figure 2) of possible location. Therefore, in this study four connection alternatives are evaluated: two located in the western zone, one in the northern zone and one in the eastern zone. First, in the lower right corner we see the first alternative located in the west of Villamaría, which goes through "La Pradera" neighborhood and connects in Manizales near the National Men's Prison on the Pan-American Highway. Secondly, in the upper left there is the second alternative located in the west of Villamaría, which, like the previous alternative, goes through "La Pradera" of Villamaría neighborhood and connects with the city of Manizales on the Pan-American Highway on "La Uribe" sector. Third, in the central part of the left there is an alternative connection located in the northern part of Villamaría that connects near "La Fuente" intersection, located on the Pan-American highway. Finally, in the eastern part of Villamaría the alternative that connects near the transport terminal is observed, so it is located close to the current connection that Manizales and Villamaría have.

3.2 Global Average Accessibility, Current Situation and Proposed Alternatives

The isochrones curves of global average accessibility can be seen in Figure 5 where minimum times of 16.59 minutes and maximums of 52.11 minutes are recorded. In the central part of the city, good coverage is observed, with average travel times of less than 25 minutes, which indicates the good accessibility of its inhabitants through the road infrastructure network. On the other hand, in the peripheral parts of the city, times greater than 40 minutes are recorded, reaching 52.11 minutes in the northwestern part of the city. Figure 6 shows the analysis made between

the isochronous curves and the population coverage. For the current situation, 32% (134 353 inhabitants) of the population obtained average travel times of less than 20 minutes. 84% (343 285 inhabitants) of the population is covered by average times of up to 25 minutes, which indicates a very favorable current scenario in terms of global average accessibility in the studied area. Figure 7 shows the result of the isochrones curves of global average accessibility for the different studied alternatives.
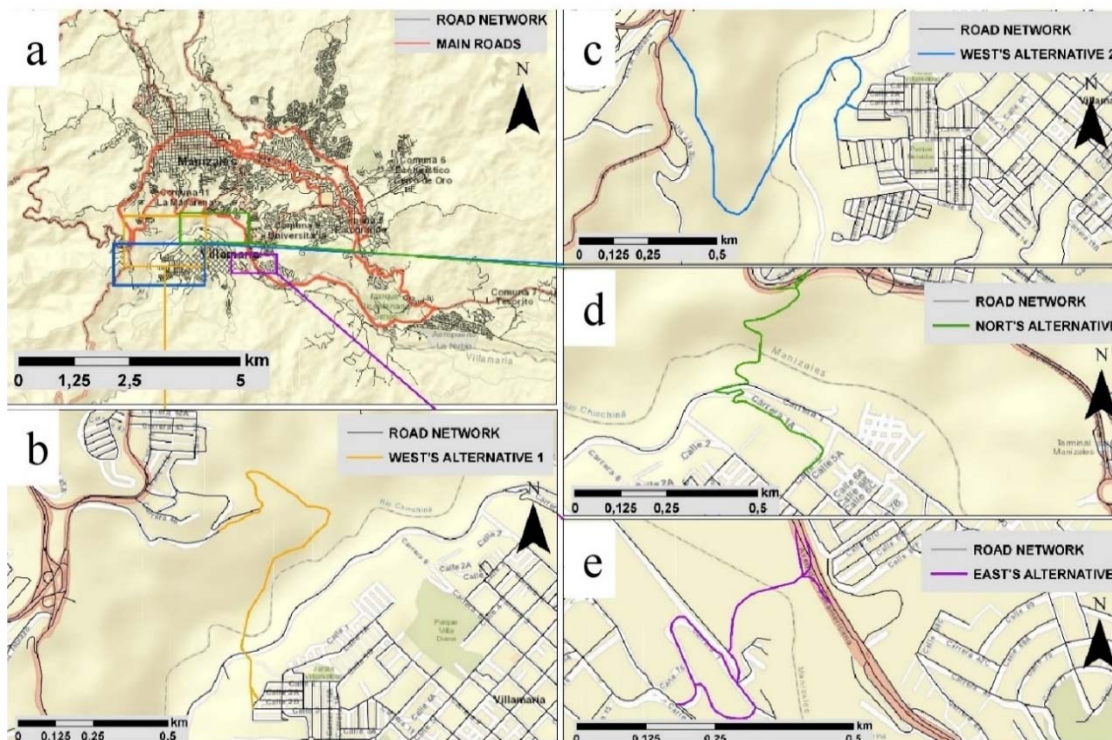
Figure 4. Road Network, a) Current situation. b) West´s alternative-1. c) West´s alternative-2. d) North´s alternative and e) East's alternative
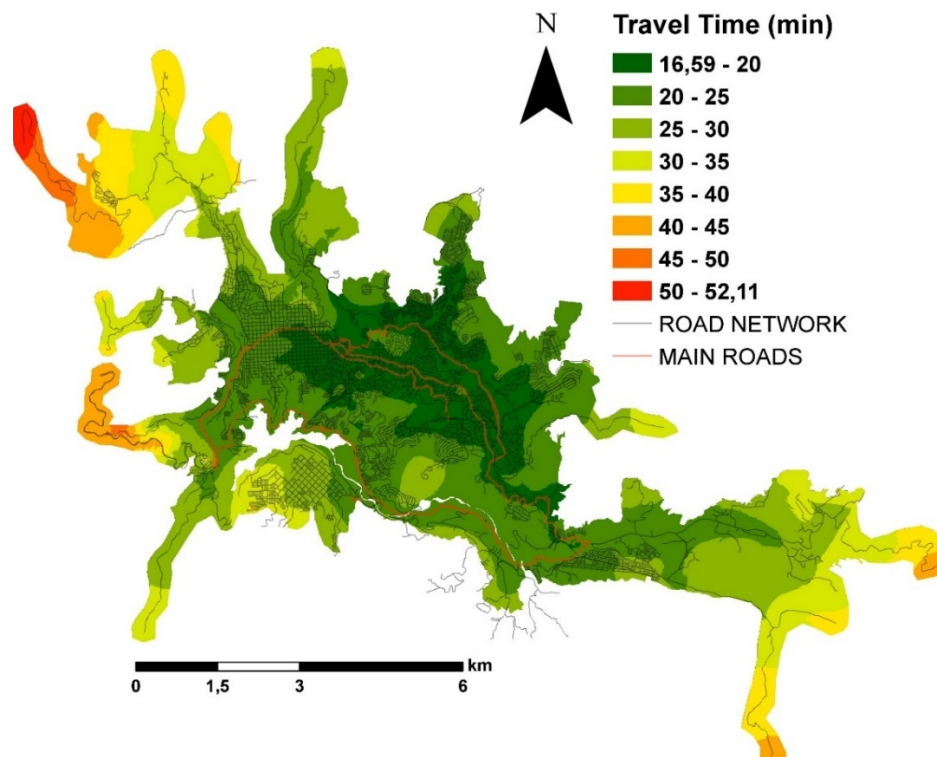
Figure 5. Global mean accessibility, current situation.
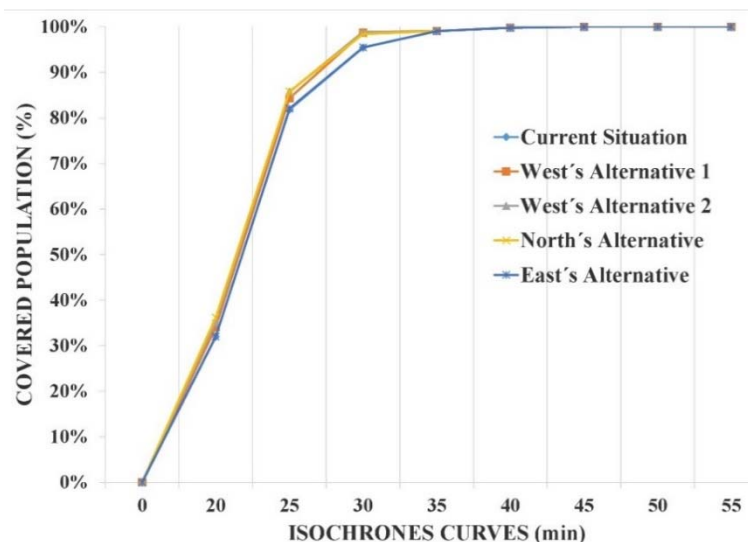
Figure 6. Covered population comparison with isochrones curves.
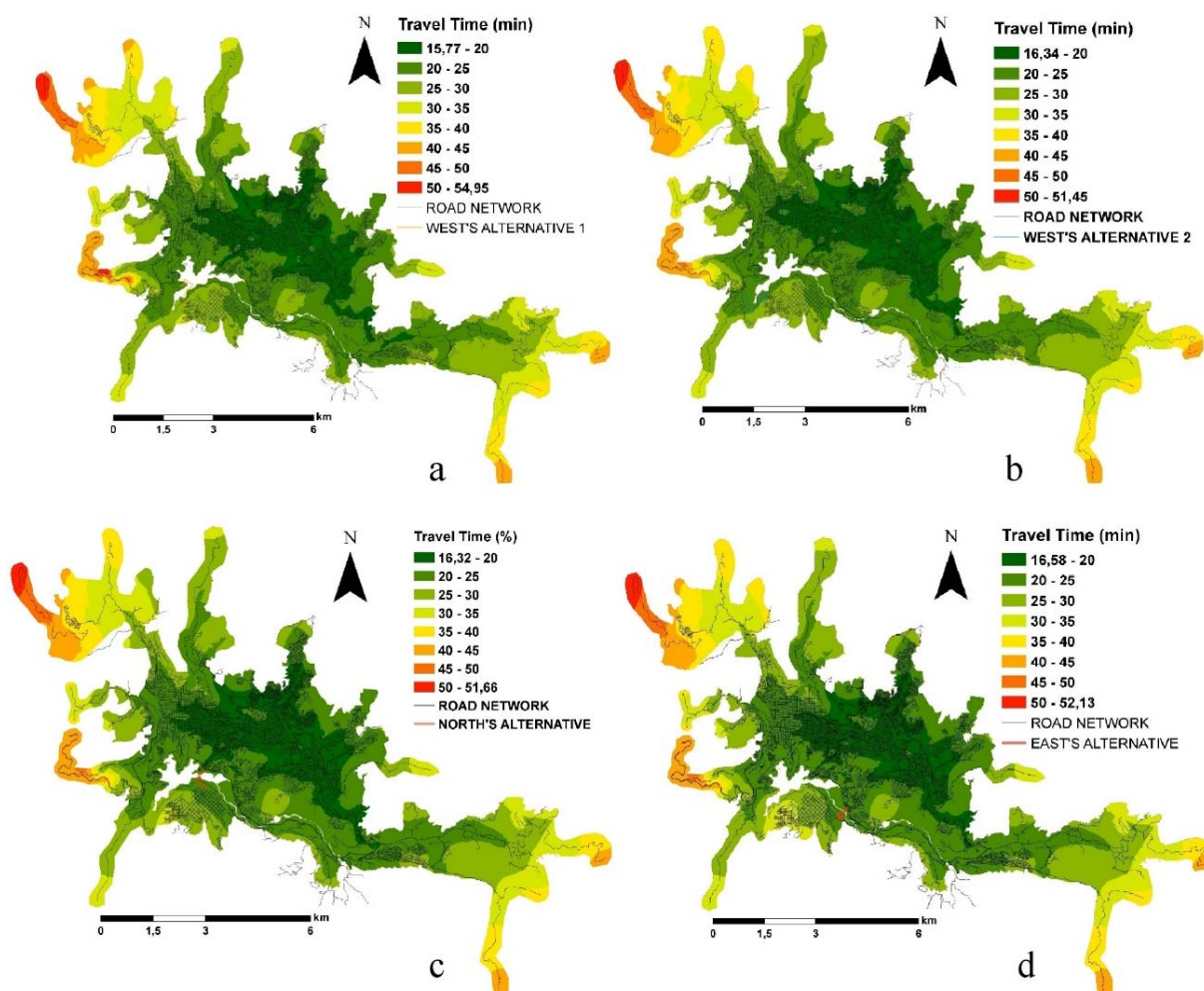
Figure 7. Global mean accessibility. a) West´s alternative-1. b) West´s alternative-2. c) North´s alternative and d) East's alternative

Among the most relevant results is that the western-1 alternative decreased the average minimum travel time by 0.82 minutes, while the other alternatives decreased it by approximately 0.20 minutes, and even the eastern

alternative did not represent significant changes since it only decreased the minimum time in 0.01 minutes. On the other hand, the analysis of population coverage, shown in Figure 6, indicates that the alternative West-2 and North increased by 4% (16 787 inhabitants) population coverage for average travel times of less than 25 minutes, while the western alternative-1 increased this percentage by 2% (8 394 inhabitants) and the eastern alternative did not generate an increase in coverage.

3.3 Savings Gradient, Current Situation vs Proposed Alternatives

Figure 8 shows the isochronous gradient savings generated by the different alternatives proposed with respect to the current situation. In these, there are savings of up to 30% in the average travel times generated by alternative West-2. Likewise, the western-1 and north alternative generate savings of up to 22.5% in the average travel times while the eastern alternative only achieves savings of up to 7.5%, making it the least efficient alternative studied. On the other hand, although the alternative West-2 is the one that generates higher savings, it does not produce savings in the whole city, as the North alternative does, which generates a saving of at least 2.5% in the entire city.
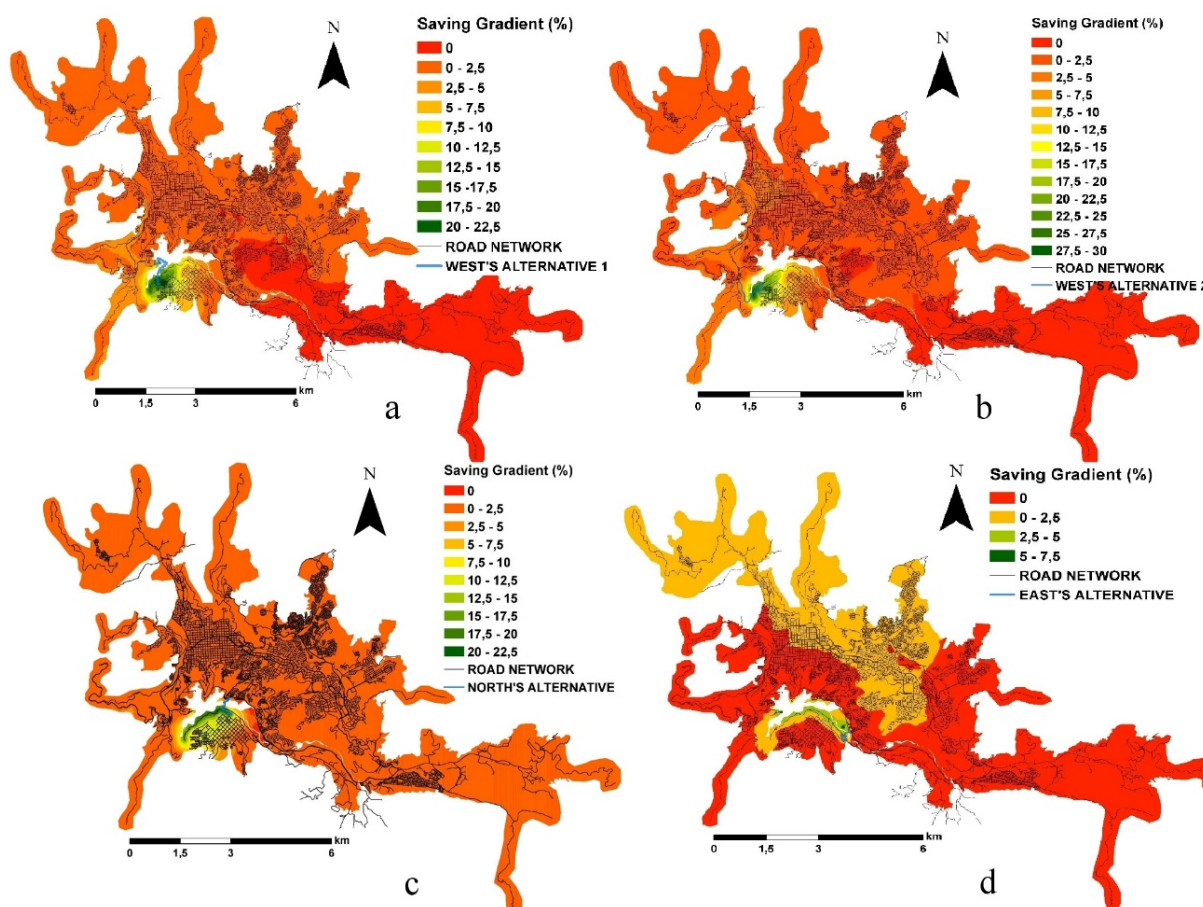
Figure 8. Saving Gradient, a) West´s alternative-1. b) West´s alternative-2. c) North´s alternative and d) East's alternative

The population coverage analysis for the isochronous gradient savings curves (figure 9) indicates that the northern alternative generates savings of up to 2.5% for the entire population followed by the western 1, western 2 and east alternative that reach coverage of 86%, 73% and 46% of the population respectively. If we continue to save up to 5%, the most convenient alternative is the West 2 with 13% (53 691 inhabitants), while the West 1 alternative reaches 10% (42 011 inhabitants) and the North alternative 9% (39 447 inhabitants). In this case, the eastern alternative already shows its infeasibility because it generates savings of up to 5% for only 1% of the population, which compared with the other alternatives is extremely unfavorable. It should be noted that the different alternatives, except for the eastern alternative, continue to generate savings in some percentage of the population, reaching a maximum, previously mentioned. Figures 10 to 13 show the analysis of population coverage, according to the socioeconomic stratum of each of the analyzed alternatives. This indicates that the population of stratum 3 (medium-low) obtains a higher percentage of savings, in all the proposed alternatives, except in the eastern

alternative (see figure 13), in which the coverage of the savings generated is lower compared with the other strata. In addition, it should be noted that the stratum 1 (low), has significant savings in the different alternatives, which indicates that connectivity is improved to a percentage of inhabitants who have disadvantages at a social and economic level.
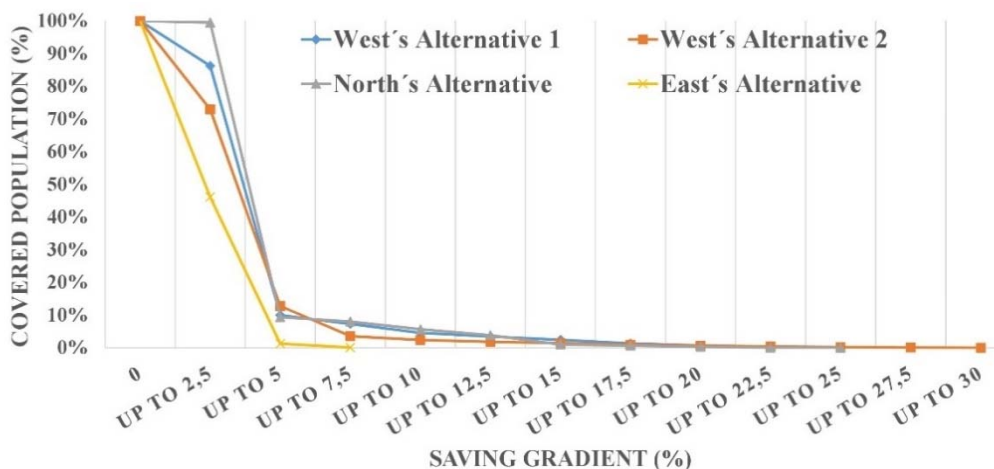
Figure 9. Covered population and saving gradient (%)

Figure 10. Covered population and saving gradient (%), strata analysis in west´s alternative-1

4. Conclussions

From the alternatives proposed as second access to Villamaría, all generated savings in the average travel times, however the eastern alternative, being close to the access that is in operation generates very low savings, making it unviable in the first instance. On the other hand, the western alternative-2 being at the entrance of Manizales and connected with the neighborhood "La Pradera" in Villamaria, which has a high average travel time in the current situation, generates savings in average travel times of up to 30%, being the one that generates the highest savings. Also, the alternatives West-1 and north generate up to 22.5% savings, however, although the alternative West-1 has the same output from Villamaría as the alternative West-2, it has a connection in Manizales that does not favor it as alternative West-2. As for the north alternative, it has a connection in Villamaría on the central part of the municipality, which helps savings to be distributed in a better way, as well as its connection with Manizales, making savings of at least 2.5% in all the area of study, something that is only achieved with this alternative.

Figure 11. Covered population and saving gradient (%), strata analysis in west´s alternative-2

Figure 12. Covered population and saving gradient (%), strata analysis in north´s alternative
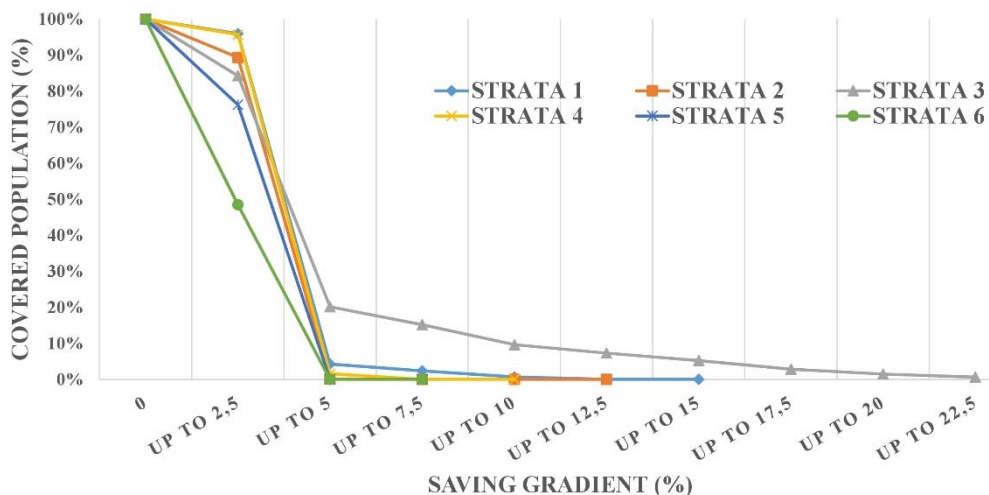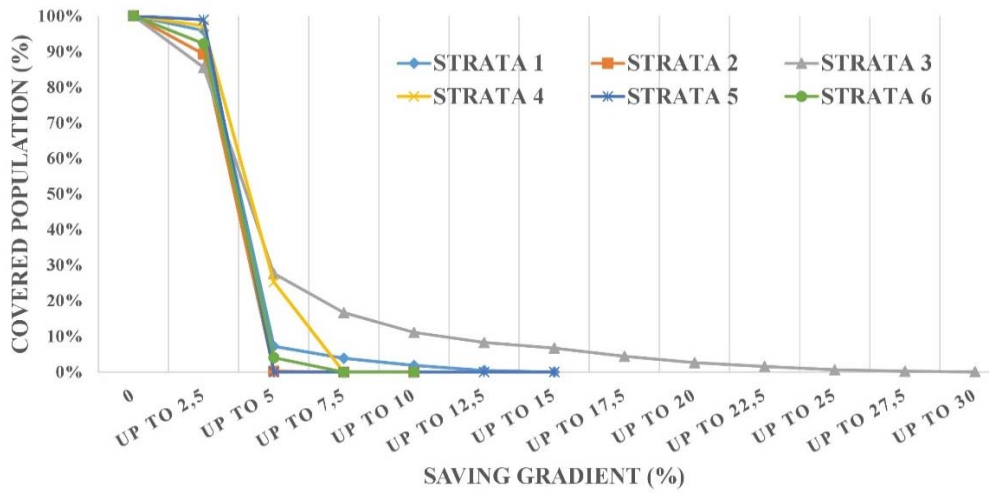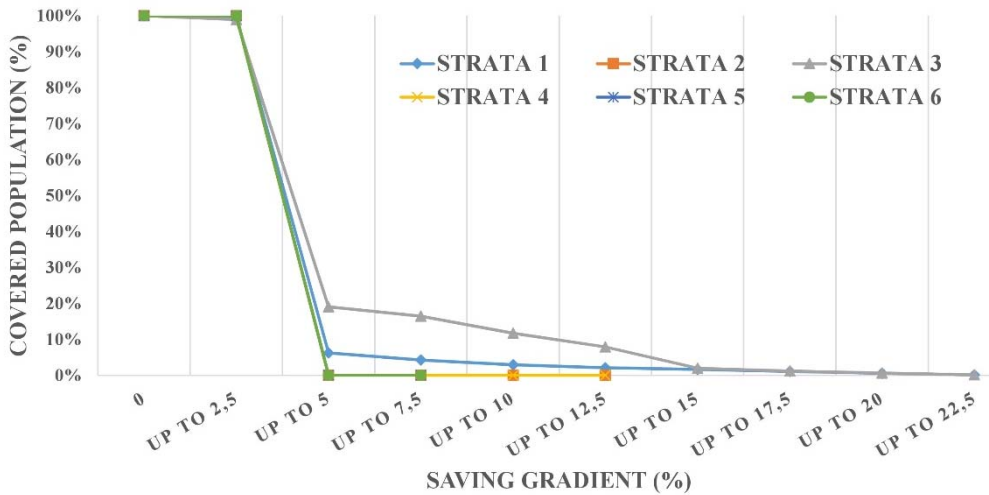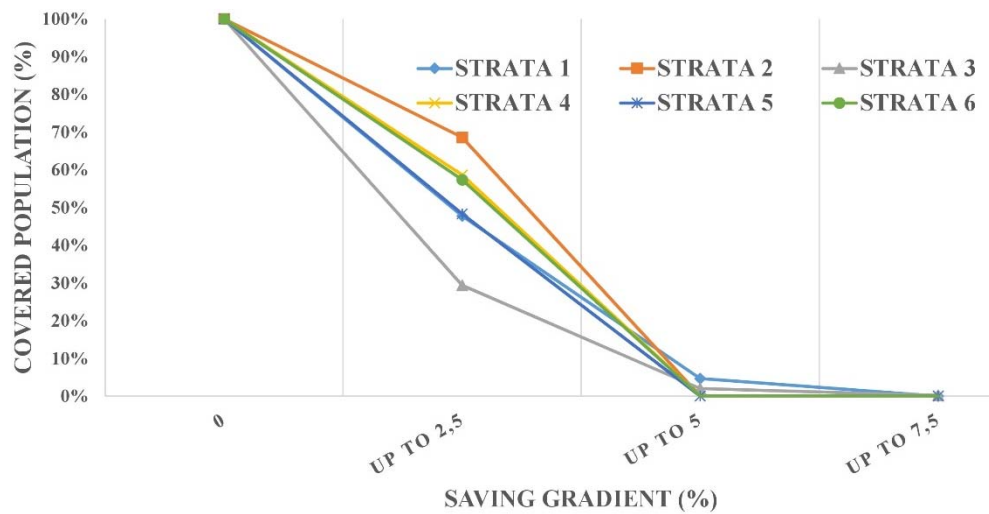

Figure 13. Covered population and saving gradient (%), strata analysis in east´s alternative

In conclusion, the alternative that generates the greatest benefit in terms of savings in average travel times to a greater percentage of the population is the northern alternative, followed by the alternative West-2 which generates considerable savings especially in the part of Villamaría with lower accessibility, "La Pradera" neighborhood. For this reason, in the pre-feasibility phase, two alternatives should be considered to make more cost-benefit studies and thus determine which of these will be considered for its construction. These subsequent studies could be complemented with supply modeling, taking into account the update of the origin-destination matrix made for the MMP 2017.

Acknowledgments

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Explaining Individuals' Usage of Social Commerce: A Data Mining Approach

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Abstract

With the use of Web 2.0 technology, e-commerce is undergoing a radical change that enriches consumer involvement and enables a better understanding of economic value. This emerging phenomenon is known as social commerce. Social commerce (s-commerce) presents a new alternative for consumers to search for and find information about products they are seeking to buy. In spite of its universality, the adoption of this burgeoning technology is affected by several factors. This research project is an initial attempt to explore individuals' intention of s-commerce usage through the data mining approach. The data was collected via a web-based questionnaire survey of 360 social network site (SNS) users in Jordan. Data mining techniques were then used to analyze the collected data in order to figure out what group of features is best for predicting s-commerce adoption among SNS users. The results showed that data characteristics related to gender, monthly income, civil status, number of connections, and prior online shopping experience are key factors in the classification process. The findings may assist researchers in investigating social commerce issues and aid practitioners in developing new s-commerce strategies.

Keywords: social commerce, social network sites, data mining

1. Introduction

In today's rapidly evolving online world, the growth of social network sites is continually bringing new concepts to light. One of the main concepts that has emerged due to the existence of both Web 2.0 technologies and social media is social commerce (s-commerce). According to Zeng, Huang, and Dou (2009), online transactions (e-commerce) have developed into s-commerce due to the interactions and connections between people, especially on social networking sites (SNSs). S-commerce differs from e-commerce in that it is established on several kinds of social media platforms, including Facebook, Instagram, and Twitter. It uses social media to support commercial activities (Chen & Shen, 2015). S-commerce is often represented as a subarea derived from e-commerce (Hajli, 2013; Sturiale & Scuderi, 2013); Wu, Shen, and Chang (2015) defined it as "word-of-mouth applied to e-commerce."

Although social commerce is a new trend, this phenomenon has developed quickly and remarkably (Barnes, 2014). Social platforms such as social networking sites have their own role in the s-commerce advancement. A report conducted by Barclays (2012) shows that half of the U.K. consumer population will be part of the s-commerce phenomenon by 2021. A new report conducted by We Are Social reveals that 2.80 billion users are active on various social network sites, amounting to 37% of the total global population in 2018 (Kemp, 2018). HnyB Insights (2014) published a report stating that the revenue of global s-commerce is growing year by year, predicting the market to reach $80 billion U.S. dollars by 2020. Popular social networking sites such as Facebook, Instagram, and Twitter have their own impact on s-commerce growth. Facebook is considered to have a noticeable share in s-commerce activities. In 2015, the number of purchases increased to 52%, in comparison with the previous year (McCarthy, 2015). According to Chaykowski (2015), 50 million small companies have Facebook pages to communicate with their customers, 4 million companies pay for advertisements on Facebook, thus demonstrating the platform's influence on electronic commerce in general and s-commerce in particular. Facebook's Instagram subsidiary also plays an important role in s-commerce; on that platform, 4.21% of users interact with popular commercial brands, a rate 58 times higher than brand engagement on Facebook (Mathison, 2018).

A growing body of literature recognizes the importance of s-commerce and SNS usage among people of different ages and social statuses. In this context, the greatest significance of s-commerce is its capacity to become the most universally adopted platform for electronic commerce worldwide (Zhang & Benyoucef, 2016). To date, however, there are few studies published in this field. Nevertheless, authors of studies such as the one conducted by Chen and Shen (2015) assert that research on s-commerce is increasing. To take advantage of s-commerce, Hennig-Thurau, Hofacker, and Bloching (2013) and Liébana-Cabanillas and Alonso-Dos-Santos (2017) believe that s-commerce consumer behavior should be studied. In the Hashemite Kingdom of Jordan, 67% of adults have internet access, whereas 90% of these users are active on SNSs; in comparison, rates in other economically advanced countries such as the United States and the United Kingdom are lower: 71% and 66%, respectively (Poushter, 2016). Thus, this issue is considered vital in this setting and area, and it requires an extensive push for further study. In an attempt to achieve this goal, the key objective of this paper is to examine patterns in the existing data to predict the factors that may affect s-commerce adoption depending on personal and SNS usage-related features.

The paper is divided into five sections. In the introduction, we present the logic and main purpose of the study; in the second section, we review previous studies in this field. The third section consists of the research methodology, followed by a comparative analysis and its results in the fourth section. The paper will end with a summary of the study's findings and a discussion on possible future research.

2. Background

S-commerce, or social commerce, is defined as commerce activities mediated through social network sites. Jascanu, Jascanu, and Nicolau (2007) stated that through different SNS avenues such as reviews, ratings, chat rooms, locator applications (geo-tagging), ranking, and recommendations, customers have been enabled to share their information, experiences, and opinions related to different products and services. Yahoo! was the first to introduce the term "social commerce" in 2005 (Jascanu et al., 2007), and since that time, it has been described as a new and powerful phenomenon. This novel advancement in e-commerce makes consumers active participants in the online business process (Hajli, 2015). Statistics show that s-commerce has developed notably since its inception, allowing the creation of new business models based on online communities (Hajli, 2015). Social commerce has gained wide popularity since 2005. For example, a survey with 2 000 respondents conducted by Immediate Future (2010) indicated that 53% of U.K. consumers review products and services online. This survey also revealed that those reviews are 157% more influential than traditional advertising methods. A report conducted by McKinsey revealed that Chinese people spend 78 minutes per day in s-commerce activities (as cited in Chiu, Ip, & Silv, 2012), and around 50% percent of Chinese people buy products depending on the online recommendations of relatives and friends (Liu, Chu, Huang, & Chen, 2016).

S-commerce has benefits for both customers and firms because s-commerce platforms simplify both consumer-to-consumer (C2C) and business-to-consumer (B2C) connections. According to Xiang, Zheng, Lee, and Zhao (2016), consumers have the ability to interact with other consumers who can help them when choosing products and services. Moreover, they can take advantage of ratings and reviews of products and sellers left by other online actors (Zheng, Zhu, & Lin, 2013). Based on these reviews and ratings, customers can evaluate a product's quality and decide whether they desire it. Additionally, they may know more about the seller's credibility and the online shopping experience. Jascanu et al. (2007) state that social commerce gives consumers an opportunity to share information and express their opinions about purchasing products. Kietzmann, Hermkens, McCarthy, and Silvestre (2011) argue that social media influences a firm's reputation and impacts its transactions. As a result, firms should pay attention to social media and the emergence of new concepts such as s-commerce.

Several previous studies indicate that s-commerce has a positive influence on firms. Kim and Park (2013) state that 300 Korean s-commerce firms have gained approximately $300–$500 million in sales. Thus, firms can increase their profits by attracting buyers via positive recommendations (Curty & Zhang, 2011). To take advantage of this form of commerce, firms may use SNSs in an attempt to sell products, in addition to asking their consumers to comment and write about their experiences on social platforms in order to introduce their products and services. Via strategic use of s-commerce, companies can enhance their relationships with consumers and therefore increase both sales and brand loyalty (Hajli, 2014). Moreover, s-commerce provides businesses with a variety of ways to build customer relationships, reduce marketing expenses, and increase sales (Chen, Lu, & Wang, 2017). Dell and H&M are examples of major companies that use s-commerce to present their products (Hajli, 2015).

However, several factors influence the presence of customers in s-commerce. Wigand, Benjamin, and Birkland

(2008) state that customers' need to be independent, successful, and connected to others are key factors that motivate them to participate in s-commerce. Sharma and Crossler (2014) use both the trust theory and uses and gratifications theory to clarify consumers' intention to adopt s-commerce. They found that trust factors such as security, privacy, and information quality influence the intention to be engaged in s-commerce. Zhang, Gupta, and Zhao (2014) designed a model based on a stimulus–organism–response model to investigate the factors affecting participation in s-commerce. Technological environmental features such as interactivity, personalization, and sociability have an impact on the customer's experience regarding social support, social presence, and flow, which in turn influence the intention of s-commerce adoption. Thus, interactions between customers (i.e., expressing their opinions and sharing information) will increase the trust and therefore increase the social support.

Previous studies have established that gender, age, prior online shopping experiences, and income affect consumers' adoption of e-commerce and s-commerce. Rodgers and Harris (2003) studied the role of gender in e-commerce adoption, which was analyzed together with the role of prior experience of online shopping. Other studies such as those by Zhang, Benyoucef, and Zhao (2015); Rapp, Beitelspacher, Grewal, and Hughes (2013); Z. Li and C. Li (2014); and Chang, Yu, and Lu (2015) hold that consumer demographics such as age and income play a role in s-commerce adoption in addition to being factors that may help companies and industries leverage their marketing potential.

3. Research Methodology

This research applies data mining techniques and methods to generate new knowledge using data collected from a launched survey about social commerce. One of the aims of this research is to examine the capacity of data mining techniques to predict s-commerce usage among SNS users. The study uses a mixed-methods approach based on three steps. Namely, examine datasets against main classifiers; feature selection and weight the features using decision tree. The implementation of this study depends on WEKA software, which offers several classification methods (Witten, Frank, Hall, & Pal, 2016).

The study survey contained general socio-demographic questions such as age, gender, income, and study and work field. The remaining sections were related to technology use such as type of smartphone used, internet access, experience in the internet field, and experience with s-commerce and e-commerce. In total, 49 features were extracted. The collected data were analyzed in order to discover any common features between heavy and non-heavy s-commerce users.

Data were classified depending on how many times the respondent logs on to social networks to make purchasing decisions about a new product or service. The classes are split into six categories: None, 0–2, 3–5, 6–8, and 9–11/times per week, and more than 12 times per week. In this project, two data sets were generated from the same collected data.

Table 1. Dataset2 – Key

Features	Key	Count	percentage
F1 Gender			
Female	1	218	61%
Male	2	142	39%
		360	100%
F3 Civil status			
Single	1	205	57 %
Married	2	155	43%
		360	100%
F6 Monthly income			
Less than 150 JD	1	78	21%
150 -300 JD	2	53	15%
300-500 JD	3	65	18%
500-800 JD	4	46	13%
800-1000JD	5	42	12%
1000-2000 JD	6	22	6%
2000-3000 JD	7	40	11%
More than 3000 JD	8	14	4%

		360	100%
F37 Number of connections on SNS			
Less than 50	1	37	10%
100-50	2	46	13%
300-100	3	102	28%
500-300	4	60	17%
1000-500	5	60	17%
2000-1000	6	22	6%
3000-2000	7	4	1%
More than 3000	8	29	8%
		360	100%
F49 Prior experience – online shopping			
Yes	1	180	50%
No	0	180	50%
		360	100%
Class -- how many times using social commerce per week			
(0-2)	1	190	53%
(3-5)	2	0	0%
(6-8)	3	43	12%
(9-11)	4	14	4%
More than 12 times	5	54	15%
I don't use online shopping	6	59	16%
	(Low: 1+6) (High:3+4+5)	360	100%

In the first data set (Dataset1), we gathered the 0–2 and None categories, classifying them as the Low class, whereas the rest of the categories (3–5, 6–8, 9–11, more than 12) were classified as High. However, after running an analysis, the accuracy results obtained from Dataset1 were 0.68. In an attempt to make clear separation between the two classes (high and low class), and to get better accuracy results, we modified our classification from Dataset1 to generate Dataset2 as follows: we deleted the 3–5 category in order to clearly distinguish between the heavy s-commerce users' group and the low s-commerce users' group. Then we gathered the 0–2 and None categories and classified them as a Low class, whereas the 6–8, 9–11, and more than 12 categories were gathered under the High class (Table 1). The sample evaluated in Dataset1 contained 452 full responses. After modification (i.e., deleting the 3–5 category), in total, 360 full responses remained in Dataset2; of these, 92 cases were deleted.

Our analysis proceeded along the following steps. First, we examined the two datasets against well-known classifiers, which we will explore in the next section. In the second step, the best subset of features was selected by applying an auto feature selection process. Finally, in the third step, we studied the weight of each feature by using the decision tree algorithm. We illustrate more details about the analysis process in the following section.

4. Experiments and Results

4.1 Data Mining Methods

Data mining uncovers new significant connections, patterns, and orientations by analyzing the data through statistics, machine learning, artificial intelligence (AI), and data visualization techniques. This process efficiently points out implicit, previously obscure, and potentially useful information found in the collected data, thus enabling the discovery of predictive patterns, the creation and testing of hypotheses, and the production of insight-provoking visualizations (Han, Pei, & Kamber, 2011).

4.1.1 Classification Algorithms

In the first step of data analysis, we selected several classification algorithms that had the potential to yield good results. Some well-known WEKA classifiers were used in addition to two decision tree algorithms (J48 and REPTree), the Naive Bayes (NB) Bayesian classifier, Multilayer Perceptron (MLP), and a Nearest Neighbor algorithm (k-NN).

Reduced Error Pruning Tree (REPTree)

A classifier used in dealing with noise in decision tree learning, the REPTree was introduced in the post-pruning process based on the ideas of Quinlan (1987) and Pagallo and Haussler (1990; Brunk & Pazzani, 1991). Fürnkranz

and Widmer (1994) described the algorithmic process as follows: in the first step, the data are divided into two sets. The first is the growing set, generated through a realization of learning algorithms, whereas the second is the pruning set, which is produced through deleting literals and clauses from the theory until it results in a predictive accuracy decrease measured through the pruning set.

J48 Decision Tree

J48 is a decision tree stemming from the C4.5 decision tree algorithm (Kabakchieva, 2013). The C4.5 decision tree algorithm points at data through information entropy (Quinlan, 1993). Al-Zoubi, Alqatawna, and Faris (2017) described the repeated process applied on smaller subsets as follows: an attribute is selected from the collected data at each node by splitting the representative into subsets through the information gained criteria, resulting in a decision based on the highest attribute value.

Naive Bayes (NB)

The Naive Bayes (NB) is a probability theory-based algorithm that receives an independent contribution from each feature and exports it to the output class (al-Zoubi et al., 2017). In this process, no explicit classifiers are used. Despite its simplicity, Han et al. (2011) defended the algorithm's equality of accuracy in pragmatic applications.

Multilayer Perceptron (MLP)

Multilayer Perceptron (MLP) is one of the more commonly approached artificial neural networks; it uses one or multiple hidden layers embedded as an aid to help expand the network's ability to model complex functions (Paola & Schowengerdt, 1995). Al-Zoubi et al. (2017) described its function as an information processing system consisting of several layers used to map the input data into fitting sets of outputs. In the MLP, the input layer is passive, whereas both the hidden and output layers process the data actively (Zare, Pourghasemi, Vafakhah, & Pradhan, 2013).

k-Nearest Neighbor (k-NN)

The k-Nearest Neighbor algorithm (k-NN) is a closest training example in feature space classifier that is based on instance learning or lazy learning (Aha, Kibler, & Albert, 2013). The close instance is determined by using distance measurements and functions such as Euclidean, Minkowski, and Mini- max (Al-Zoubi et al., 2017). Kabakchieva (2013) described it as one of the most average machine learning algorithms because its classification process is established on a majority vote from the object's neighbors, thus assigning it to the most common class amid the k-nearest neighbors.

4.2 Evaluation Measurements

Figure 1, and table 2 shows the evaluation criteria used in this work, which is known as a confusion matrix.

		Predicted class	
		Positive	Negative
Actual class	Positive	True Positive (TP)	False Negative (FN)
	Negative	False Positive (FP)	True Negative (TN)

Figure 1. Confusion Matrix

Table 2. Evaluation Criteria Description

Evaluation criteria	Equation	Description
Accuracy	$$Accuracy = \frac{TP + TN}{TP + FN + FP + TN}$$	Estimated by dividing the numbers of all correct instances by that of all instances in the data.
Precision	$$Precision = \frac{TP}{TP + FP}$$	Estimated by the division of the percentage of correctly predicted instances by the total number of

		predicted instances.
Recall	$Recall = \dfrac{TP}{TP + FN}$	Calculated by dividing the ratio of correctly classified instances by the number of actually classified instances.
F-measure	$F - measure$ $= \dfrac{2 \times Precision \times Recall}{Precision + Recall}$	Calculated by the weighted average of the Recall and Precision.

We examined Dataset1 and Dataset2 against the classifiers: J48, REPTree, NB, MLP, and k-NN. As explained previously, Dataset1 contains all the categories, with (0–2 and None) classified as Low and (3–5, 6–8, 9–11, and more than 12) classified as High. Table 3 shows the best accuracy rate for Dataset1 as 60.84%, achieved by the REPTree classifier, followed by the NB and J48 with 59.96% and 57.96%, respectively. MLP and k-NN demonstrated the worst accuracy rates, with 54.87% for each. The best recall and F-Measure were also obtained by REPTree, whereas the second-best recall and F-Measure were achieved by NB, with 62.2% and 63.1% respectively. Moreover, the highest classifier for the precision was the NB, with a 64% rate, and the second highest results were achieved by REPTree.

Table 3. Dataset1 Results

Data1	All Features		
Measure	**Accuracy**	**Recall**	**Precision**	**F-Measure**
J48	57.964	0.614	0.619	0.617
RepTree	**60.840**	0.667	0.638	0.652
NB	59.955	0.622	0.640	0.631
MLP	54.867	0.582	0.592	0.587
k-NN	54.867	0.574	0.593	0.584

Unlike Dataset1, Dataset2 achieved higher results (see Table 4). By removing the 3–5 category from the main class, the results improved in all measures. The best classifier for sorting the High and Low users was REPTree, with a 66.66% accuracy rate. The second-best result was obtained using the NB classifier. However, similar to Dataset1, REPTree achieved the best results for F-Measure and recall measures, with 78.6% and 88.8%, respectively.

Table 4. Dataset2 Results

Data2	All Features		
Measure	**Accuracy**	**Recall**	**Precision**	**F-Measure**
J48	61.111	0.767	0.700	0.732
RepTree	**66.667**	0.888	0.706	0.786
NB	65.556	0.711	0.773	0.741
MLP	61.389	0.727	0.718	0.723
k-NN	61.111	0.675	0.740	0.706

As mentioned in Section 4.1, the data with the best results, Dataset2, will go through an auto feature selection process.

4.3 Feature Selection (FS)

Feature selection (FS) can be applied to increase the accuracy rate of the classification (Al-Zoubi et al., 2017). In the machine learning context, the FS method reduces the dimensionality of data without losing any information. This technique is used in the processing phase of the methodology to try to select the best subset of features and remove unneeded or irrelevant features (Faris, Ala'M, & Aljarah, 2017; Faris et al., 2018), thus improving the results.

Table 5. Dataset2 Auto Features Selection

Dataset2-best-Features	TOP-5				
Measure	Accuracy	Recall	Precision	F-Measure	Auto feature selection process-Result
J48	**69.167**	0.932	0.712	0.807	**F1:** Gender.
RepTree	68.056	0.944	0.699	0.803	**F3:** Civil states.
NB	**69.167**	0.843	0.745	0.791	**F6:** Average monthly income.
MLP	68.056	0.863	0.726	0.789	**F37:** The number of connections on the most used social network platforms.
k-NN	68.611	0.839	0.741	0.787	**F49:** Prior experience in online shopping.

Next, as a second step, we analyzed the data with the highest results using an auto feature selection method to select the best feature subset. In our case, out of 49 features collected via online survey, five features were selected using the auto feature selection technique: F1: Gender: female; F3: Civil status: single; F6: Average monthly income; F37: Number of connections on the most used social network platforms; and F49: previous experience in online shopping.

As shown in Table 5, all measures achieve a better result than the previous experiments did. The best accuracy was obtained by the J48 and NP, with a nearly 2.5% increase over all feature data in Table 3. In addition, the best recall and F-Measure also show a notable increase, with a 5.6% and 2.1% increase, respectively, which was achieved by REPTree. The classifier with the highest precision was the NB, with 74.5%.

4.4 Decision Tree

A decision tree is a tree-form graph of the possible consequences and outcomes of several choices. The tree helps to weigh these possible choices based on their probabilities, cost, and benefits. To be more specific, it is a decision support tool that can be used to map an algorithm in order to mathematically predict the most suitable choice (Safavian & Landgrebe, 1990). In our case, the next step in analysis was to run the selected features on the decision tree classifier in order to analyze and weigh the features. The outcomes are illustrated in Figure 2.
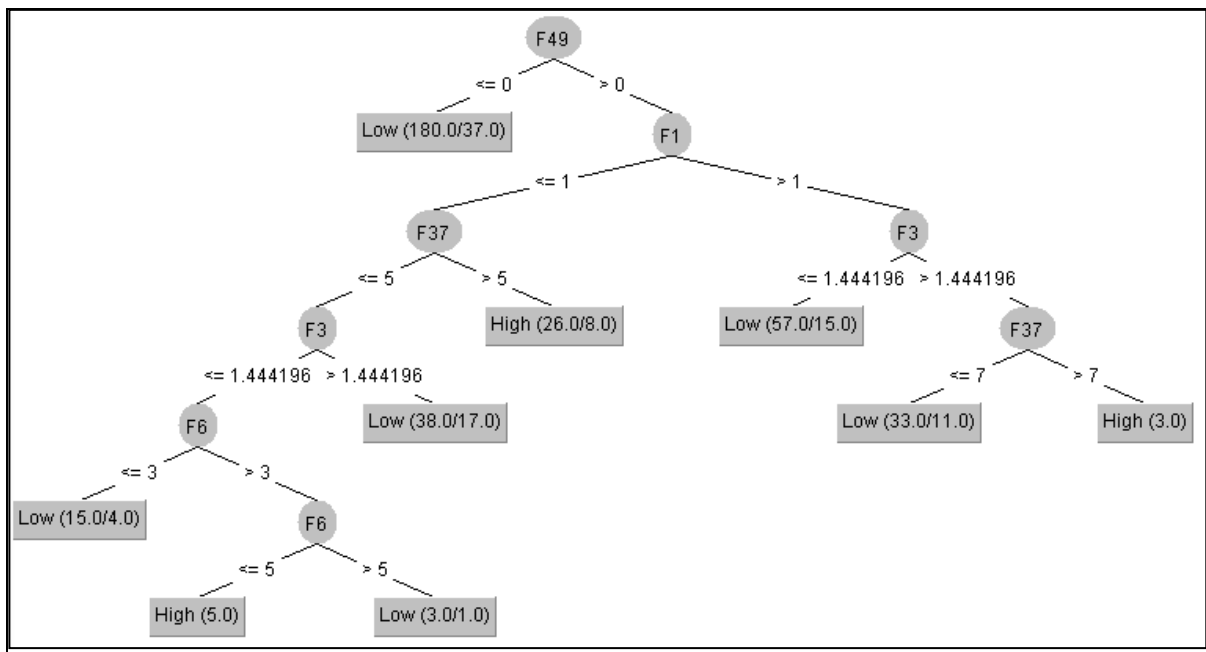

Figure 2. J48 Tree Model Dataset2

A summary of the rules that can be concluded from the J48 Tree Model Dataset2 in Figure 2 will be highlighted in the following section.

5. Discussion

As several reports have suggested, s-commerce is characterized by two facets: social sharing and social shopping (Chen & Shen, 2015). Arising from the feature selection technique, the number of users' connections on SNSs (F37) is among the best selected subset features that could influence the users' adoption of social commerce services. This finding validates the assertion that social shopping is affected by a person's relationship with the surrounding community and other consumers, especially when consumers' acquaintances take part in shopping decisions and other social practices that take place during the process (Chen & Shen, 2015). This study supports evidence from previous observations (e.g., Chen & Shen, 2015; Hajli, 2013) that demonstrated that both informational support and emotional support from a user's connections on social network can have an effect on his or her online shopping behavior.

Notably, the results confirm the relationship between gender (F1) and civil status (F3) and their association with intensive use of s-commerce. This finding supports evidence from Awad and Ragowsky's (2008) previous observations that women place greater value on online comments from other consumers, which confirms the role of gender in online shopping. Moreover, many researchers, including Campbell (2000) and Dittmar, Long, and Meek (2004), have noted that female users have a more positive attitude regarding online shopping compared to male users.

This study's findings also indicate that users with good prior experience of buying online from different websites (F49) will be strong candidates to be heavy s-commerce users. In addition, our findings support the idea that consumers who had a long and positive previous experience with shopping online using traditional websites such as Amazon and eBay will have a high capacity to use social networks to seek information for products and make an actual purchase decision. In other words, the users who have these characteristics will be strong social commerce users. Although immediate conclusions are available, these findings need further analysis

5.1 Algorithm mapping- Decision Tree Rules

Table 6 depicts a summary of the extracted rules from Figure 2. The rules encompass five features: (F1) representing gender, (F3) representing civil status, (F6) representing monthly income, (F37) representing number of connections on SNSs, and (F49) representing prior experience in online shopping.

Table 6. Rules for Dataset2

Rule sequence	Rules	Class
R1	F49 <= 0	Low
R2	F49 > 0 & F1 >1 & F3 <= 1.44	Low
R3	F49 > 0 & F1 >1 & F3 > 1.44 & F37 <= 7	Low
R4 (H1)	F49 > 0 & F1 >1 & F3 > 1.44 & F37 > 7	High
R5 (H2)	F49 > 0 & F1 <= & F37 > 5	High
R6	F49 > 0 & F1 <= & F37 <=5 & F3 > 1.44	Low
R7	F49 > 0 & F1 <= & F37 <=5 & F3 <= 1.44 & F6 <=3	Low
R8 (H3)	F49 > 0 & F1 <= & F37 <=5 & F3 <= 1.44 & F6 > 3 & F6 <=5	High
R9	F49 > 0 & F1 <= & F37 <=5 & F3 <= 1.44 & F6 > 3 & F6 >5	Low

As shown in Figure 2, the starting point (first branch) of all decision tree rules is F49, which stands for prior online shopping experiences. As seen in Table 6, nine rules were extracted from the decision tree, of which three rules (R4, R5, and R8) are labeled as High. Thus, these are a significant group of factors that may predict heavy s-commerce use. In the following cases, the rules' effectiveness is estimated by the fulfillment of the factors given a specific number. The rules can be illustrated as follows:

— R4 (H1), being the first of the High class rules, it develops as follows: if F49 (representing prior experience in online shopping) is higher than 0 as a result of being represented by 1 (according to the key in Table 1, 1 means yes) and if F1 (representing gender) is higher than 1 (meaning it is 2 and according to the key in Table 1 means male) and F3 is higher than 1 (meaning it is 2 and according to Table 1 means single) and F37 is higher than 7 (thus. according to Table 1, the number of connections on SNSs exceeds 2 000), then the prediction of being a heavy social commerce user is high; three cases fulfill all the above factors.

In brief, R4 (H1) predicts that if users have prior online shopping experience and are single males who have more than 2 000 connections on SNSs, they are likely to be heavy SNS users; three cases reach the end of the branch. The same analysis is applied to all the rules whether the class is High or Low.

— The second High rule R5 (H2) predicts that users with prior online shopping experience who are females and have more than 500 SNS connections are likely to be heavy social commerce users, with an accuracy of 26:8 cases (out of 34 cases, 26 cases fulfill all the above factors and 8 do not).

— The last High-labeled rule R8 (H3) predicts that users with prior online shopping experience who are single females with a number of SNS connections equaling or less than 500 and an income between 300 and 1 000 JDs monthly are likely to be heavy social commerce users, with an accuracy of five cases fulfilling the rule.

— As shown previously, the Low class rules can be analyzed in the same manner.

The most important finding that we may extract from Figure 2 is that individuals with no prior experience in online shopping are less likely to be heavy social commerce users, with an accuracy of 180:37 cases (Rule 1).

5.2 Research Implications

The findings of this study have a number of important implications for future practice. In an immediate application, they can serve as guidelines for s-commerce community managers and firms planning to reap the benefits of investing in s-commerce. As the results show, factors such as gender, civil status, number of connections that users have on social networks, and prior experience in online shopping are among the most important components of s-commerce usage. These features can be rendered as base pillars for investors interested in s-commerce and its implementation in their businesses. As recommended by Chen and Shen (2015), businesses may consider new initiatives such as providing innovative one-click sharing functions on SNS platforms and encouraging the sharing of high-quality content through monetary or virtual rewards. Businesses may also use the features uncovered by this study to target s-commerce campaigns by using popular topics and expert contributors to reach out to potential consumers in a smart and innovative way. It is important to remember, however, that s-commerce facilitation is based on relational factors. Through the presented findings, companies could find new ways to develop and sustain mutually beneficial and long-term relation with s-commerce users.

This study has examined consumers' use of social commerce by analyzing different user features. A total of 49 features were extracted using data mining, which is a long-established approach for determining the significance of these features. A number of auto-selected features have been found to have a direct influence on s-commerce usage. Academic attention to these features, as well as investigations of other potentially influential features and their role in online shopping, will form a more comprehensive picture of s-commerce and further improve our current understanding of this emerging phenomenon. This research has uncovered many questions in need of further investigation. Typically, data mining aligns well with unstructured data. The data set analyzed in this research project was collected using an online survey, limiting the number of individual features that could be surveyed, collected, and then analyzed. More extensive work on the socio-demographic characteristics of online users and s-commerce participants is therefore required.

The findings of this research can be a milestone in shedding further light upon s-commerce data mining project implementations. Future research could include additional possibility changes in the data set, offering a new setting for the classification algorithms' parameters, and so on in an attempt to achieve highly accurate results and extract additional important information from the available data. To the best of our findings and knowledge, this implementation project is one of the pioneer studies using data mining techniques to examine data sets established based on an online survey to analyze human behavior in relation to specific technological use.

The key contribution of this study is paving the way for academics and researchers to use data mining in social science studies. It attempts to analyze the performance of classification algorithms used in data mining based on a data set collected via online survey to evaluate their utility in fulfilling the research project's goals and objectives. Further studies using this methodology should analyze the sufficiency of available data in producing reliable predictions, thus looking at any required changes during the data collection phase or any additional ways to improve the process.

Finally, more research and studies on the use of the data mining approach in social studies would help to establish a greater degree of accuracy in this realm. Combining the auto selection feature technique with a decision tree is strongly recommended as a means to explain feature selection results and, consequently, to evaluate users' behavior and technology adoption process. This type of research could help provide businesses' managers and academics with strategic and academic recommendations.

6. Conclusion

The proliferation of social networks has unleashed myriad new opportunities as well as new obstacles for researchers and businesspeople alike (Chen & Shen, 2015). For example, SNS-based market predictions are now more accurate due to information exchange in social networks (Qiu, Rui, & Whinston, 2013). This research project is an initial attempt to explore individuals' social commerce usage intention using a data mining approach. This project's findings were obtained by applying data mining classification algorithms and an auto feature selection method to the collected data because each classifier of the five under consideration proceeds differently. We have noticed that the data related to gender, civil status, monthly income, number of connections, and prior online shopping experience are among the major factors influencing the classification process.

In the applied realm, these findings will assist practitioners in improving their future social commerce strategies. Meanwhile, these findings can also guide researchers' investigations of social commerce issues. We believe this project to be a primary step toward better applying data mining in social science studies because the methodology employed can be further used in laying the first brick for additional social science data mining implementation projects.

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The Role of Government Schools in Creative Education of Students in the State of Kuwait

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Abstract

This paper focuses on identifying the role of government schools in creative education of students from the point of view of primary school teachers in the State of Kuwait. It also aims at finding the difference in the role of the school in the creative education of students due to the variables of experience, qualification, and specialization. The sample of the study consisted of 265 teachers from the primary government schools selected by random stratified method. A questionnaire was developed and its validity and reliability was verified. The questionnaire consisted of 45 items distributed over 5 themes; the administration, teachers, curriculum, school building, community, and parents.   The results of the study showed that the role of schools in the creative education of students from the point of view of primary school teachers in government schools in the State of Kuwait was moderate. The results showed no statistically significant differences at the level ($\alpha = 00.05$) due to years of experience, qualifications, and specialization in all themes. In the light of the results of the study, several recommendations were made to improve the role of primary school in the creative education of students.

Keywords: creative education, Kuwait, school

1. Introduction

Creativity is one of the important educational goals that educational societies aspire to achieve. It is considered the supreme human language, which is mature. Although it is innate, an individual is not born creative but is born with seeds of creativity within him. In fact, the process of creativity is the outcome of meeting a set of factors or criteria. It has to do with the highest mental functions adequacy and more emotional qualities in the creative person. However, the best climate suitable for creative thinking can be experienced as we look at the guidance of the Prophet, peace be upon him, in developing the creativity of Companions (Abdul, 2006).

As innovation today is a secret of success and excellence in various themes, it enables the owner of the detection and invention of new ways and means to seek change and development. This is done in light of the fact that evolution has become a prerequisite and it generates the ability to deal with new situations, especially unfamiliar ones. In addition, it helps to discover the relationships that link different information. New ways to interact with quick variables make the most of the tools and ideas available (Almshrfe, 2005).

If innovation is a requirement in all social institutions, it is therefore necessary to start with the educational institutions represented by the schools, which are responsible for raising and educating the members of the society. This would make them effective members who contribute to the development of their society, and also help them to find solutions to the problems they may face in the future. It is logical for students to demand creativity. Hence, the teacher is at loss if he is unable to help the students to become creative and excellent. This, however, explains the futility of traditional education.

Although there is some care for creativity in some Arab countries, this care is still limited and insufficient to reach the care required to provide creativity. Thus, this gives us optimism about the transition from traditional

schools to effective schools. Here, the student finds appropriate care for his abilities and contributes effectively in caring for creative and talented people (Bovetin, 2012).

The creative education works on self-realization and is based on the development of individual talents and improvement of human growth. Creators contribute to the productivity of the entire society culturally, economically, and scientifically. Creativity is one of the educational goals. In view of this, it is clear how important creative education is, and how it is directed towards the goal that educational processes seek to achieve, namely: creating and forming a creative human being capable of meeting the challenges of the times (Ajez & Sheldan, 2010). Therefore, this study aims to identify the status of creative education in the Kuwaiti government schools in Farwaniya Governorate from the point of view of the primary school teachers and their perceptions of their development.

2. Research Problem

The theme of education is witnessing an advanced scientific renaissance that affected all aspects of education. The role of the school is been developed according to various international developments and is no longer confined to the process of reducing information. However, it has risen to the level of attention to various aspects that are directly related to personality (individual personality) to be able to learn and create. It is clear that modern schools seek to achieve the integrated development of the personality of the individual from the cognitive and emotional aspects and skills. Therefore, teaching individuals how to be creative is the importance of creative education by teachers to help students reach the degrees of creativity in various themes. This is because basic education is the basic room in the discovery of creativity and development. Therefore, it seeks attention and should be applied at the primary stage. This study answers the following questions:

Question 1: What is the role of the government schools in creative education of students from the point of view of primary school teachers in the State of Kuwait?

Question 2: Are there statistical significant differences ($\alpha \leq 0.05$) in the role of the government schools in creative education of students from the point of view of primary school teachers in the State of Kuwait due to teacher's experience, qualification, and specialization?

3. Importance of the Study

The importance of the current study is to reveal the role of schools in creative education for students from the point of view of primary school teachers in government schools in Kuwait. It also helps to reveal the statistical significant differences ($\alpha \leq 0.05$) in the role of schools in creative education of students from the point of view of primary school teachers in Kuwaiti government schools due to experience, qualification, and specialization for female teachers.

4. Objectives of the Study

The study sought to achieve the following objectives:

- To identify the role of schools in creative education of students from the point of view of primary school teachers in Kuwaiti government schools.

- To reveal the statistical significant differences ($\alpha \leq 0.05$) in the role of the government schools in creative education of students from the point of view of primary school teachers in the State of Kuwait due to experience, qualification, and specialization for female teachers.

5. Study Terminologies

Creative Education: This is the education that encourages learners to think analytically about their own learning processes, combining global and local factors in the learning processes, and providing general and specific strategies for a wide variety of learning environments. Thus, learners may be able to take greater control of their own thinking and learning in various aspects (Rojanapanich & Pimpa, 2011, p. 103).

Kuwait Government Schools: The schools that funded and operated the Ministry of Education in the State of Kuwait.

Primary School Teachers: Teachers who teach primary school students aged 4-11 years old in Kuwait government schools.

6. Limitations of the Study

The study is subject to the following limitations:

- Location Limitations: The study was applied in government schools in Farwaniya Governorate in Kuwait.

- Time Limitations: The study was conducted in the first semester of 2016/2017.

- Human Limitations: This study was applied to female primary school teachers working in government schools in Farwaniya Governorate in Kuwait.

7. Previous Related Studies

The study revealed some studies related to creative education as follows:

Asaf (2013) conducted a study aimed at identifying the attitudes of social studies teachers towards developing the skills of creative thinking among the students of the upper elementary stage in the Directorate of Third Amman Education and its relation to the variables of scientific qualification and experience. A random sample of 133 teachers was selected in order to identify the following: teachers' attitudes toward developing creative thinking abilities, teachers' attitudes towards the detection and identification of creative skills, and teachers' attitudes towards encouraging and adopting creativity. The study found that teachers who follow the trend with a view of developing the creative thinking skills of the students are positive. This is with significant differences in the attitudes of the teachers towards developing the creative thinking skills of the students due to the variable of the academic qualification and the holders of the postgraduate certificate. There are no statistically significant differences in the teachers due to the variable of experience.

Trifonova (2012) conducted a study aimed at introducing an innovative educational approach through the design of the game of scenarios by teachers and participation in creative teaching practices, as well as training workshops. The study sample consisted of 21 teachers, including teachers from 7 primary and secondary schools in Spain. In order to achieve the objectives of the study, teachers were trained to design teaching scenarios and put them into practice in teaching contexts. The main results showed that teaching processes that involve the design of lessons electronically by teachers contributes to the development of creativity among students, which was seen as an incentive for teachers and students. The results also revealed the obstacles that hinder the student to develop his creativity. The method of designing the lessons electronically by the teachers and their application by the students contribute to support the creative and creative learning environment.

Robina (2010) conducted a study aimed at identifying the capacity of the education system in Pakistan to promote creativity for children. The study sample consisted of 154 children who took the Torrance creative thinking tests. To achieve the objectives of the study, the classrooms were monitored in 16 elementary schools on a documentary analysis of educational policy documents, curricula, and textbooks. The main findings are that children could produce ideas, but appears to be weaker in other themes. This is attributed to the fact that the attitudes of teaching in Pakistan are aimed towards acquiring knowledge only, which has contributed to discouraging creativity. The results also found obstacles to the promotion of creativity related to the teacher who resort to traditional methods of teaching, and obstacles that are related to the curriculum. The study showed the need to involve parents in developing the curriculum since the educational system is permanent.

Ozmen and Muratoglu (2010) conducted a study in Turkey aimed at identifying the creative competencies of school principals, particularly in the theme of knowledge, application, and management strategies. The study sample consisted of 214 principals and teachers, including 100 principals and teachers who responded to a questionnaire specially designed to achieve the study objective. The study showed that the most important creative competencies that the manager must possess are: effective knowledge management, the formation of social support networks, and organizational and management competencies. The study showed that there are no statistically significant differences between males and females based on perceptions about the nature of creative competencies that must be possessed by the school principal.

Huwailah and Huwaila (2009) conducted a study in the State of Kuwait aimed at revealing the degree of practice of principals in the Ahmadi educational district based on the behaviors of achieving Administration innovation. The sample consisted of 66 principals in addition to a random sample of 208 teachers, and the researchers used a questionnaire consisting of 23 items. The results of the study showed that the degree of practice of principals of secondary schools in the Ahmadi educational system of Administration and creativity behaviors are a moderate assessment from the point of view of teachers. However, from the results of the study, there were no statistically significant differences in the responses of managers by the variables of educational qualification and experience, and in the teachers' responses by sex and transgender experience. Also, there is existence of significant differences by variable educational qualification for the benefit of bachelor degree or higher degree.

Enezi (2008) conducted a study in Saudi Arabia aimed at revealing the level of Administration creativity of the principals in the north of Saudi Arabia from the point of view of teachers and educational supervisors. The sample consisted of 536 teachers and educational supervisors randomly selected. The study showed that the level

of Administration innovation among school principals was moderate from the point of view of educational supervisors. On the other hand, it plays a strong role from the point of view of teachers. The results also showed that there are statistically significant differences due to the impact of educational function in all themes. Also, there was the existence of significant differences between the category of Master's degree and the categories of diploma and bachelor degree. However, more were in favor of the categories of diploma and bachelor degree in the themes of fluency and originality. There was also existence of significant differences between the category of bachelor degree and the category of Master's degree in the theme of sensitivity to problems.

Sharari (2008) also conducted a study in Saudi Arabia aimed at revealing the role of the principals in the development of creativity among teachers in Al-Jouf region in Saudi Arabia from the point of view of the teachers. The study found that the role of school principals in developing the creativity of teachers in the theme of social relations, management, expression, dialogue, and discussion played a very significant role. It also shows that the role of principals in developing creativity among teachers in the practical theme of Faculty was also paramount, as well as the improvement and development of the school environment. The study found out that there are significant statistical differences for the role of school principals in the development of creativity among teachers due to the variable sex in favor of females and years of experience.

Yahyaoui (2007) conducted a study in the Kingdom of Saudi Arabia aimed at identifying the Administration creativity in the government secondary schools for girls in Madinah in terms of the availability of the elements of creativity among the managers, the extent of their practice of Administration innovation, and the expected obstacles to their practice of Administration innovation. The study aimed at identifying the views of principals and teachers on the availability of creativity components of the principals. Also, the sample of the study of all members of the original community consisted of 111 directors and agents, and 1,185 teachers.

Wfry (2006) conducted a theme study in the United States that examined the relationship between the level of organizational creativity of the American school principal and effective learning. The study also aims to describe the indicators of quality communication and dialogue between the principal and individuals during creative processes, and its impact on the learning process. The results of the study were derived from a series of theme studies that were conducted on 13 school projects in 13 American schools. The researchers relied on the method of the interview, in which they deliberately interviewed 8-12 individuals in each project, including a director. Consequently, key variables included the following: Leadership, process characteristics, nature of decision making, level of participation, performance measurement criteria, sequence of learning process, learning about the organization, and appropriate organizational conditions for applying the learning type. The study found the following results: On the quality of learning processes in the organization, the role of the leader in educating and training individuals on the right communication methods, and raising the level of participation in decision-making processes, to unify the goals and trends among individuals have a significant influence on the learning process. As a result of the learning process, the above factors increase the creativity of individuals as well as the effectiveness of applying creative ideas.

Kandemir and Gur (2006) conducted a study aimed at surveying, observing, and discussing some of the different views of mathematics teachers in improving creative thinking through problem solving. The study sample consisted of 43 teachers. To achieve the objectives of the study, the results indicated that there is a shortage of courses and training programs based on the training of problem-solving methods. Hence, this reduces the enhancement of creativity. This is in addition to the low level of current teaching methods, which requires redesigning curricula according to creative teaching methods.

Subaihi (2006) conducted a study aimed to identify the main obstacles facing the study population and that negatively affects their creativity. The study also aims to identify the vulnerability of each of these constraints on artistic creation process with the teacher. The researcher selected a random sample of the study population consisting of 65 teachers, which relied on a descriptive and analytical approach. Therefore, highlighting the results showed the existence of obstacles in the development of creativity, including obstacles that are related to the teacher, as well as external constraints. It does not provide the right atmosphere for the creativity of the teacher and in assigning the teacher additional work outside the scope of specialization and obstacles to creativity such as, Repetition of ideas, similarity, and inability to develop.

Diab (2005) conducted a study aimed at identifying the most important obstacles to the development of creativity among the students of the basic stage in the schools of the Gaza Strip from the point of view of their teachers. The study was applied to a sample of 100 teachers. To achieve the objectives of the study, the results of the study showed that the level of obstacles that hinder the development of creativity among the students of the basic stage in the schools of the Gaza Strip is as a result of the lack of an interesting and encouraging school

environment. Furthermore, it is also attributed to the lack of interest of the school administration in research, exploration, and discovery. This is also in addition to the lack of training courses for the teacher related to development Creativity, and lack of familiarity with the teacher strategies to develop creative thinking.

Sharari (2005) conducted a study aimed at identifying the obstacles to creativity in a sample of secondary school teachers in Al-Jouf region in Saudi Arabia. The study sample consisted of 500 teachers. To achieve the objectives of the study, the results of the study indicated that there is no exceptional system for the promotion of the creative teacher and the lack of financial resources. The study also found that there are statistically significant differences between male and female teachers in favor of males. Therefore, this is in addition to the fact that there are no differences due to scientific qualification and years of experience.

8.1 Study Population

The study population consists of 4,375 teachers in 48 government schools of the elementary stage in Al-Farwaniya Governorate in the State of Kuwait for the academic year (2017/2018).

8.2 Study Sample

The study sample consisted of 265 teachers from the total study population. The sample was chosen according to the stratified random approach. A total of 365 questionnaires were distributed to the sample of the study, and 265 (88.3%) were retrieved. Table 1 shows the distribution of the sample size according to the study variables.

Table 1. The distribution of the study sample according to years of experience, qualification and specialization

Variables	Categories	Number	Percentage
Years of experience	(1-5) Years	37	14%
	(6-10) Years	86	32%
	(11-15) Years	91	34%
	More than 15 Years	51	20%
Total		265	100%
Qualification	Bachelor	151	57%
	Postgraduate	114	43%
	Total	265	100%
Specialization	Literary	168	64%
	Scientific	97	36%
Total		265	100%

8.3 The Questionnaire

To achieve the objectives of the study, the study questionnaire was constructed in light of educational literature that was related to the subject of the study. The questionnaire consisted of 45 items which covered five themes, namely; administrative, teachers, curriculum, school building, parents, and community. It is determined by the five-point Likert scale (Very Strong, Strong, Moderate, Poor, and Very Poor) and values (5, 4, 3, 2, 1), respectively.

8.4 The Questionnaire Validity

The questionnaire validity was verified by presenting it to 10 professors of the educational administration, the educational foundations, curriculum, teaching and educational technology from the University of Jordan, Kuwait University, and the Jordanian Ministry of Education. The professors were asked to revise and review the questionnaire in terms of clarity of items and the language and degree of belonging to the theme of the questionnaire. It also modifies or deletes any item that does not achieve the objective of the study. The questionnaire was revised and amended based on the professors' comments and suggestions.

8.5 The Questionnaire Reliability

The questionnaire reliability was measured using the internal consistency method according to the Cronbach's Alpha, as shown in Table 2.

Table 2. The Cronbach's Alpha consistency coefficient values for all study themes

No	Theme	Internal Consistency
1	Administration	0.86
2	Teachers	0.89
3	Curriculum	0.93
4	School building	0.90
5	Parents and community	0.91

Table 2 showed that all the values of the coefficient of reliability (The Cronbach's alpha) for the themes of the study questionnaire ranged between 86% - 93%. These results were acceptable for the study purpose.

9. Statistical Analysis

The Statistical Package for Social Sciences (SPSS) was used to answer the study questions. In answering the first and second questions, the mean and the standard deviations were used. In answering the third question, mean, standard deviations, and the multiple analysis of variance (MANOVA) was performed. To determine the school role, the study adopted the mean of the responses of the sample members based on manual scoring to obtain the division of scores (5-1=4÷3=1.33+1= 2.33). The range of criteria based on a five point Likert scale was given as: 1-2.33= Weak, 2.34-3.66= Moderate, 3.67-5= strong.

10. Results and Discussion

The results of the study were arranged according to the study questions. Question one states "What is the role of the government schools in creative education of students from the point of view of primary school teachers in the State of Kuwait?"

To answer this question, the mean, rank, and standard deviations of the role of the school in creative education of students were analysed, as shown in Table 3.

Table 3. Mean, standard deviations, rank and the role of schools in creative education of students from the point of view of primary school teachers in the government schools in the State of Kuwait

Item No.	Rank	Themes	Mean	S. D	School Role
2	1	Teachers	3.95	0.70	Strong
1	2	Curriculum	3.61	0.87	Moderate
4	3	School building	3.58	0.91	Moderate
3	4	Administration	3.50	0.69	Moderate
5	5	Parents and community	3.14	0.96	Moderate

Table 3 shows that the mean of the school role in the creative education of students from the point of view of primary school teachers in government schools in the State of Kuwait as a whole was 3.57, with a standard deviation of 0.68, and with a moderate role. This refers to the fact that schools have to deal with the daily routine work, cover up the curriculum, as well as carry out some administration and paper work. Therefore, they do not have enough time to concentrate on creative education and its aspects. All school elements focus on the regular daily work and there are no real planned activities on creative education. The mean of all themes ranged between 3.14 - 3.95. The theme of teachers came first with the highest mean of 3.95, with a standard deviation of 0.70 and a strong role. This refers to the fact that teachers do their best in creative education through the different teaching activities. The curriculum theme scored a mean of 3.61, with a standard deviation of 0.87 and a moderate role; followed by the theme of school building with a mean of 3.58 and a standard deviation 0.91; followed by the Administration theme with a mean of 3.50, a standard deviation of 0.69 and moderate role; while the theme of parents and community came in the last place with a mean of 3.15, a standard deviation of 0.96, and a moderate role. The three themes achieved moderate role due to the fact that schools have limited services and resources that can be utilized to support creative education activities. In addition, all concerned parties except teachers have supportive role to creative education. Thus, it is still not sufficient enough from the teachers' point of view. School principals have multiple tasks and do not have enough time to communicate effectively with parents and community institutions, and their greater attention is directed to the educational process rather than to creative education requirements. Parents as well have moderate role in supporting creative education. This is because most parents are preoccupied with government and military jobs which are far from their homes, which makes communication between parents and school very weak. In general, parents are less aware of the

importance of creative education or even giving the required support to their children. Most parents visit and follow up their children only when major problem happened.

The detailed results of the teachers' theme are presented in Table 4 as follows:

Table 4. Mean, standard deviations, rank and school role

Rank	No.	Items	Mean	S.D.	School Role
1	18	The teacher takes into consideration individual differences among students.	4.45	0.92	Strong
2	11	The teacher performs the work entrusted to him/her in a professional manner.	4.37	0.92	Strong
3	15	The teacher provides learning resources that help in creative teaching.	4.36	0.98	Strong
3	14	The teacher develops training programs on teaching creative thinking skills.	4.36	0.99	Strong
5	17	The teacher provides training and activities to solve scientific problems.	4.26	0.92	Strong
6	19	The teacher uses innovative strategies that stimulate creativity.	4.12	0.92	Strong
7	13	The teacher applies the theoretical aspects in the creative application.	4.01	0.98	Strong
8	16	The teacher depends on the method of dialogue, persuasion and respect for the other opinion.	3.58	1.12	Moderate
9	20	The Teachers stimulate the gifted student.	3.51	1.46	Moderate
10	12	The teacher applies new methods to solve the problems that they face.	3.46	1.15	Moderate
Overall			3.95	0.70	Strong

Table 4 shows that the mean of the teachers' theme as a whole was 3.95, with a standard deviation of 0.70, and with a strong role. The mean of the items ranged between 3.46 and 4.45. Item 18 that stated "The teacher takes into consideration individual differences among students" scored a mean of 4.45 and a standard deviation of 0.92 with a strong school role. This is referred to as the basic role of the teachers and it takes into consideration the individual differences not only to promote creative education, but also as one of their basic duties toward their students.

Item 11 that stated "The teacher performs the work entrusted to him/her in a professional manner" ranked second with a strong role, a mean of 4.37, and a standard deviation of 0.92. Item 15 that stated "The teacher provides learning sources that help in creative teaching" ranked third with mean score of 4.36, standard deviation of 0.98, and strong role. This is referred to the fact that teachers receive professional training on creative education and critical thinking skills. Therefore, they concentrate on creative education "with a moderate of 4.36." The teacher provides training and activities to solve scientific problems "with a moderate of 4.26." The teacher also uses innovative strategies to stimulate creativity "with a moderate of 4.12." Thus, the teacher applies the theoretical aspects in the application of creativity. Furthermore, the study is based on these reports, which are evaluated on the basis of what the teacher and the educational supervisor evaluated.

Items 16 that stated "The teacher depends on the method of dialogue, persuasion and respect for the other opinion" scored a mean of 3.58 and standard deviation of 1.12 with a moderate role. Item 20 that stated "The teachers stimulate gifted and creative students" scored a mean of 3.46 and standard deviation of 1.46 with a moderate role. Item 12 that stated "The teacher applies new methods to solve the problems that they face" scored a mean of 3.46 and a standard deviation of 1.15 with a moderate role. This is referred to the fact that teachers still lack the skills needed to motivate the creativity of the learners as well as to follow the traditional teaching approaches and methods.

The detailed results of the curriculum theme are presented in Table 5 as follows:

Table 5. Mean, standard deviations, rank and school role

No.	Rank	Items	Mean	S.D.	Role

24	1	The curriculum connects the learner to the surrounding environment.	4.03	0.98	Strong
22	2	Creative activities are available in the curriculum.	3.92	0.98	Strong
21	3	The way the curriculum is structured fits into the teaching of creative thinking skills.	3.90	1.03	Strong
26	4	The curriculum contains life situations that need to be taught	3.74	1.07	Strong
28	5	The curriculum promotes the efforts of scientists, detectives and inventors.	3.62	1.66	Moderate
25	6	The curriculum develops creative abilities and talents.	3.48	1.20	Moderate
23	7	The curriculum develops entrepreneurship and experimentation.	3.38	1.11	Moderate
29	8	Curriculum evaluations focus on higher thinking skills (analysis, application, criticism, creativity)	3.31	1.10	Moderate
27	9	The curriculum contains scientific achievements and discoveries.	3.14	1.15	Moderate
Overall			3.61	0.87	Moderate

Table 5 shows that the mean of the whole curriculum theme was 3.61, with a standard deviation of 0.87, and with a moderate role. This is referred to the fact that the national curriculum still needs improvement in order to meet the creative education requirements and standards. The curriculum contains some activities that support creative education, but it needs more improvement and enrichment in areas related to creative education.

Item 24 that stated "The curriculum connects the learner to the surrounding environment" scored a mean of 4.03 and a standard deviation of 0.98 with a moderate role. This referred to the nature of the school curriculum that was built for the State of Kuwait and its environment and traditions. Therefore, the State of Kuwait follows a national curriculum that is especially designed for its students.

Item 22 that stated "Creative activities are available in the curriculum" scored a mean of 3.92 and standard deviation of 0.98, with a strong role. The Kuwaiti National Curriculum contains some activities that promote creative education. As a result, teachers considered this a strong aspect that supports the school role in creative education activities.

Items 27 that stated "The curriculum contains scientific achievements and discoveries" scored a mean of 3.14 and a standard deviation of 1.15 with a moderate role. This is referred to the fact that the curriculum is poor and does not possess enough information, activities about scientific achievements and discoveries.

Item 29 that stated "Curriculum evaluations focus on higher thinking skills (analysis, application, criticism, creativity)" scored a mean of 3.31 and standard deviation of 1.10, with a moderate role. This is referred to the current structures of the Kuwaiti National Curricula that have limited focus on the high thinking skills. Thus, this is in addition to the traditional teaching methods that teachers adopt in the delivery of curricula.

The detailed results of school building theme are presented in Table 7. To answer the items in this theme, mean, standard deviations and rank were used for the subject theme of the curriculum.

Table 7. Mean, standard deviations, rank and school role

No.	Rank	Items	Mean	S.D.	School Role
30	1	School building facilitates the preparation of students in the classroom to apply the creative approach.	4.23	1.32	Strong
33	2	School building has a library equipped with the latest educational resources.	4.11	1.17	Strong
32	3	School classrooms has modern technology that support students learning	4.09	1.19	Strong
35	4	The school building has a well-equipped library.	4.03	1.30	Strong
36	5	The school building offers mental games for	3.92	1.30	Strong

No.	Rank	Items			
		students who are creative and talented.			
34	6	The school building has all the services that support creative education.	3.91	1.32	Strong
31	7	School building has places that allow students to practice their talents such as painting and design.	3.89	1.20	Strong
Overall			3.98	0.91	Strong

Table 7 shows that the mean of the entire school building theme was 3.98, with a standard deviation of 0.91, and a strong role. This refers to the quality of the Kuwaiti schools. The Ministry of Education has invested millions of dollars over the past few years in improving the quality of school buildings, facilities, and educational resources. Item 30 that states that "School building facilitates the preparation of students in the classroom to apply the creative approach" scored a mean of **4.23** and standard deviation of **1.32** with a strong role. Item 33 that states that "School building has a library equipped with the latest educational resources" scored a mean of **4.11** and standard deviation of **1.17** with a strong role. Item 32 that states that "School classrooms have modern technology that supports student's creative education" scored a mean of **4.09** and standard deviation of **1.19** with a strong role. These results prove that Kuwaiti schools are well equipped with the required educational resources and facilities that support creative education. These resources and facilities include libraries, laboratories, classrooms, educational technologies, play areas, etc.

The detailed results of the administration theme are presented in Table 8. The mean, standard deviations and rank were analyzed for the administration theme as shown in Table 8.

Table 8. Mean, standard deviations, rank and school role

No.	Rank	Items	Mean	S.D.	School Role
10	1	The school administration clarifies its philosophy of education and its objectives for all students.	4.56	0.89	Strong
6	2	The school administration uses team work to support and create education activities.	4.51	0.93	Strong
1	3	School administration creates the appropriate organizational climate.	4.06	1.13	Strong
2	4	The school administration is concerned with the various activities of interest to the students.	4.04	1.03	Strong
9	5	School administration provides free speech to students.	3.80	1.08	Strong
8	6	School administration gives teachers the freedom to apply creative ideas.	3.73	1.05	Strong
5	7	The school administration attracts experts in the creativity of the workshops.	3.26	1.27	Moderate
4	8	School administration grants moral incentives to creative students.	3.21	1.16	Moderate
3	9	School administration grants financial incentives to creators.	3.14	1.17	Moderate
7	10	School administration uses e-management to develop creative educational services.	2.90	1.34	Moderate
Overall			3.50	0.69	Moderate

Table 8 shows that the mean of the administration theme is 3.50, with a standard deviation of 0.69 and a moderate role. Item **7** that stated "The school administration attracts experts in the creativity of the workshops" scored a mean of **3.26** with standard deviations of **1.27** and a moderate role. Item **8** that stated "School administration grants moral incentives to creative students" scored a mean of **3.21** and standard deviation of **1.16** with a moderate role. Item **9** that stated "School administration grants financial incentives to creators" scored a mean of **3.14** and standard deviation of **1.17** with a moderate role. Item **10** that stated "School administration uses e-management to develop creative educational services" scored a mean of **2.90** and a standard deviation of **1.34** with a moderate role. This is referred to traditional administration that most school principals follow in Kuwait. Principals are reluctant to move ahead with the new ideas and approaches that they get trained on, so as to support creative education activities. This is due to the comfort zone that they prefer to stay in and avoid the

change that needs time and efforts.

The detailed results of Parents and Community theme are presented in Table 9. The mean, standard deviations, and rank were analyzed for the Parents and Community theme as shown in Table 9:

Table 9. Mean, standard deviations, rank and school role

No.	Rank	Item	Mean	S.D.	The Role
45	1	The family is very interested in creative education activities.	3.64	1.32	Moderate
39	2	The family develops the talent of their children in cooperation with teachers.	3.63	1.17	Moderate
37	3	The family accepts the creative aspects of their children.	3.40	1.19	Moderate
42	4	The family provides the right atmosphere for its creative and talented children.	3.34	1.30	Moderate
43	5	The family provides the health care needed for its creative and talented children.	3.04	1.30	Moderate
40	6	The community respects creative and talented people and encourages them to practice creativity.	3.04	1.32	Moderate
41	7	The community provides specialized institutions to support talented and creative people financially and morally.	2.95	1.20	Moderate
44	8	The family follows the method of dialogue and discussion with their children.	2.74	1.31	Moderate
38	9	The family communicates effectively with the school administration.	2.58	1.21	Moderate
Overall			3.15	0.96	Moderate

Table 9 shows that the mean for parents and the community theme was 3.15, with a standard deviation of 0.96 and a moderate role. Item **7** that stated "The community provides specialized institutions to support talented and creative people financially and morally" scored a mean of **2.95** and standard deviation of **1.20** with a moderate role. Item **8** that stated "The family follows the method of dialogue and discussion with their children" scored a mean of **2.74** and standard deviation of **1.31** with a moderate role. Item **9** that stated "The family communicates effectively with the school administration" scored a mean of **2.58** and standard deviation of **1.21** with moderate role. These results indicated that parents and community are still not aware of the importance of creative education and creativity for children. Most parents are interested in students' academic achievements rather than creativity or students' critical thinking practices.

Results and Discussion of Question Two: Are there statistical significant differences ($\alpha \leq 0.05$) in the role of the government schools in creative education of students from the point of view of primary school teachers in the State of Kuwait due to teachers experience, qualification, and specialization?

To answer this question, the mean, standard deviations, and the multiple analysis of variance (MANOVA) were used as shown in Table 10 below:

Table 10. Mean, standard deviations, and the multiple analysis of variance (MANOVA) for the responses of the sample members due to the variables of experience, academic qualification, and specialization

Variable	Categories		Administrative	Teachers	Curriculum	School Building	Parents and the Community	Total
	(1-5)	M	3.50	3.88	3.48	4.02	3.09	3.51
		S	0.71	0.80	0.94	0.91	1.02	0.76
Experience	6-10	M	3.50	4.01	3.74	3.99	3.21	3.63
		S	0.69	0.60	0.79	0.87	0.90	0.58
	11-15	M	3.50	3.97	3.63	4.00	3.42	3.83

		S	0.70	0.83	0.84	0.89	0.89	0.83
	>15	M	3.50	3.91	3.81	3.97	3.86	3.81
		S	0.68	0.70	0.80	0.91	0.90	0.86
	Bachelor	M	3.50	4.00	3.76	4.02	3.33	3.65
Academic		S	0.72	0.66	0.76	0.79	0.86	0.63
Qualification	Postgraduate	M	3.50	3.90	3.37	4.01	2.84	3.44
		S	0.67	0.78	1.00	0.97	1.04	0.74
	Literary	M	3.81	3.61	3.73	3.98	3.67	3.81
Specialization		S	0.91	0.81	0.79	0.93	0.81	0.86
	scientific	M	4.10	3.91	3.88	3.56	3.87	3.57
		S	0.81	0.91	0.79	0.73	0.81	0.91

M=Mean, S= Standard Deviation

Table 10 shows an apparent discrepancy in the mean and standard deviations based on the role of the school in the creative education of the students according to the variable of experience for the primary school teachers in the government schools in the State of Kuwait (α=00.05). Also, the table shows differences due to the academic qualification (undergraduate and graduate) and specialization variable (literary and scientific). Multiple analysis of variance (MANOVA) was performed to find out the statistical significance of the differences between the mean. This can be shown in Table 11 below:

Table 11. Multiple analysis of variance (MANOVA) for the responses of the role of the school in creative education of students due to the variables of experience, academic qualification, and specialization

Source of Variation	Themes	Sum of Squires	Degree of Freedom	Mean of Squires	F Value	Sig.
Experience Wlx.0=896 f=0.005	Administration	0.000	1	0.000	0.000	0.99
	Teachers	0.129	1	0.129	0.262	0.61
	Curriculum	0.571	1	0.571	0.78	0.38
	School building	0.321	1	0.321	0.67	0.37
	Parents and the community	0.042	1	0.042	0.047	0.83
	Total	0.090	1	0.090	0.197	0.66
Qualification holing 0.096 F=0.021	Administration	0.000	1	0.000	0.001	0.997
	Teachers	0.206	1	0.206	0.418	0.519
	Curriculum	3.753	1	3.753	5.106	0.511
	School building	4.12	1	4.12	6.12	0.612
	Parents and the community	6.426	1	6.426	7.263	0.431
	Total	1.116	1	1.116	2.445	0.120
Specialization HOLING=0.012 F=0.83	Administration	0.075	2	0.075	0.217	0.643
	Teachers	0.169	2	0.169	0.362	0.550
	Curriculum	0.378	2	0.378	0.741	0.393
	School building	0.207	2	0.207	0.414	0.523
	Parents and the community	0.092	2	0.092	0.111	0.740
	Total	0.130	2	0.130	0.417	0.512
The error	Administration	61.915	228	0.484		
	Teachers	62.959	228	0.492		
	Curriculum	94.085	228	0.735		
	School building	86.20	228	0.832		
	Parents and the community	113.254	228	0.885		
	Total	58.450	228	0.457		
Total	Administration	1691.018	265			

Teachers	2135.875	265	
Curriculum	1836.025	265	
School building	2325.617	265	
Parents and the community	1440.741	265	
Total	1759.281	265	

* Statistically significant   α=0.05

Table 11 shows that there are no statistically significant differences (α= 0.05) due to years of experience, qualification, and specialization for all themes. This result can be attributed to the fact that schools fulfill their duties in creative education in the same way and under the same conditions. This is because these are government schools which have similar educational facilities and resources. In addition, teachers have the same qualification and work condition.

11. Conclusion and Recommendation

The findings from the study show that the school role in creative education of students, from the point of view of primary school teachers in the government schools in the State of Kuwait as a whole, was moderate role. Schools have no time to concentrate on creative education and its aspects. More so, school elements focus on the regular daily work and have no real planned activities on creative education. The role of the school elements in creative education varies. On the one hand, teachers believe that they have strong role. On the other hand, they believe that the curriculum, the school building, the school administration, and parents and community have a moderate role.

In the light of the study results, it recommends:

- School curriculum needs to be enhanced with creative education tools and activities.
- Teacher's skills and practices that support creative education practices should be improved.
- School buildings and resources needs to be improved to support creative educational practices.
- Involvement of parents and community in supporting schools' creative education activities.

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Travelling Salesman Problem Solution Based-on Grey Wolf Algorithm over Hypercube Interconnection Network

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Abstract

Travelling Salesman Problem (TSP) is one of the most popular NP-complete problems for the researches in the field of computer science which focused on optimization. TSP goal is to find the minimum path between cities with a condition of each city must to visit exactly once by the salesman. Grey Wolf Optimizer (GWO) is a new swarm intelligent optimization mechanism where it success in solving many optimization problems. In this paper, a parallel version of GWO for solving the TSP problem on a Hypercube Interconnection Network is presented. The algorithm has been compared to the alternative algorithms. Algorithms have been evaluated analytically and by simulations in terms of execution time, optimal cost, parallel runtime, speedup and efficiency. The algorithms are tested on a number of benchmark problems and found parallel Gray wolf algorithm is promising in terms of speed-up, efficiency and quality of solution in comparison with the alternative algorithms.

Keywords: grey wolf optimizer, chemical reaction optimization, meta-heuristics, Travelling salesman problem

1. Introduction

Due to the large increases in the number of cities in the world, mobility between cities has become difficult because of there existing many dissimilar roads to reach the same city with different travelling cost (Vukmirović and Pupavac, 2013), where there are several places that are all directly connected to each other by different long roads and the passenger wants to make the shortest trip. Some Algorithms can be used to guide people using one of the transport or movement methods (walking, train, car, and bus) to reach their destination on the shortest route. (Zhan and Noon, 1996).

TSP is arisen in many different practical applications such as School bus routes, Computer wiring, job-shop scheduling and many more (Matai, et al., 2010). While there is many applications of TSP then applied new algorithms and architecture could give the opportunity to inspire new solutions that could be better than existing ones, which means, optimizing for all of these applications.

TSP has received great interest from researchers and mathematicians, as it is easy to describe, difficult to solve. TSP problem has a place in a big class of problems known as NP-complete, as shown in Figure 1. In particular, if an efficient algorithm (polynomial time) can be found for solving TSP, then efficient algorithms could be found for all others. (Karla, et al., 2016).
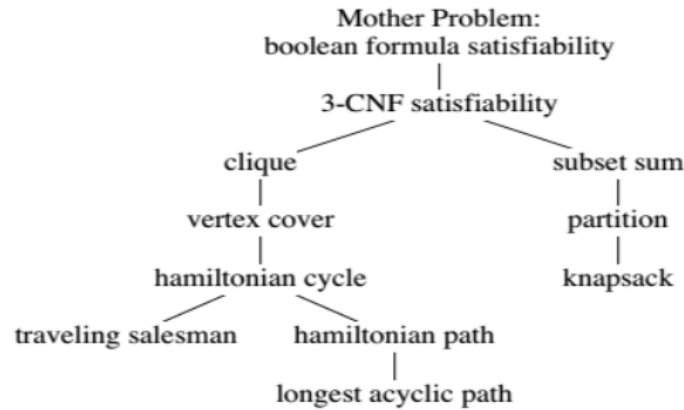
Figure 1. NP – Complete Problems (Al-Shaikh, et al., 2016)

TSP is the problem of finding the shortest route between cities or nodes which classified as minimization problem (Lam and Newman, 1985), the problem is to create the shortest route in the form of aggregation to visit each node exactly once and then return to the initial node (Kan and Shmoys, et al., 1985).

TSP is a permutation problem which required O (n!) as time complexity (Kaempfer and Wolf, 2018). There exist an algorithm called Held and Karp algorithm as in (Chekuri, 2017) based on dynamic programming to solve TSP where they reduce the computational time complexity to O (2nn2) but it's still too high for solving big size of real-world instance.

1.1 TSP Formulation

Miller (as cited in Sawik, 2016) shows that TSP can be defined as an integer linear program as follow:

$$X_{ij} = \begin{cases} 1 & \text{There is rout from city i to city j} \\ 0 & \text{No rout} \end{cases}$$

Where x is a variable for an n city problem, by defining the Travelling cost between two cities i and j is $c_{i.j}$ and u_i is a temporary variable, Miller shows how TSP can be defined as an integer linear program as :

$$\min \sum_{i=0}^{n} \sum_{j \neq i, j=0}^{n} c_{ij} x_{ij} \tag{1}$$

$$\text{Subject to: } 0 \leq x_{ij} \in \{0,1\} \leq 1 \qquad i,j = 0, \dots., n \tag{2}$$

$$u_i \in Z \qquad i = 0, \dots., n \tag{3}$$

$$\sum_{i=0, i \neq j}^{n} x_{ij} = 1 \qquad j = 0, \dots \dots, n \tag{4}$$

$$\sum_{j=0, j \neq 1}^{n} x_{ij} = 1 \qquad i = 0, \dots \dots, n \tag{5}$$

$$u_i - u_i + n x_{ij} \leq n - 1 \qquad 1 \leq i \neq j \leq n \tag{6}$$

Where equations 2 and 3 are used to ensure that each city on the route can only arrive from another city exactly once, Equalities 4 and 5, it is necessary for each city on the route, there is an exit to the another city. Finally, equation 6 is used to ensure that there is only one route covering all cities, which means that they cant be multiple, simultaneous and unconnected paths.

While the importance of the TSP in numerous fields and for its applications, many researchers solve it using different approaches aspiring to get a better solution than existing such as : Bee Colony Optimization (BCO) (Wong, el al., 2008), Ant Colony Optimization (ACO)(Yang, et al., 2008), Firefly algorithm (FA)(Kumbharana and Pandey)(2013) and Heuristic Algorithm (Hernández, el al., 2016). These methodologies do not generally locate the optimal solution. Rather; they will often find the near-optimal solutions for the problem. Most of these algorithms called Swarm optimization (SO) (Poli, el al,2007) or Meta-Heuristic optimization mechanisms (Blum, el al, 2007), SI is an intent of design or distributed problem-solving inspired devices by the collective behavior of colonies of insects social and other sociedades animals (Raja, 2015), which can be used to solve many types of optimization problems. As an examples in natural systems of Swarm optimization are include Bacterial Growth (Zwietering, el al.,1990), whales (Mirjalili and Lewis, 2016), Bird Flocking (Reynolds, 1987), Fish Schooling (Bastos, et al., 2008) and spiders (James and Li, 2015). Swarm intelligence techniques become very popular and commonly used in solving many types of optimization problems due to many advantages, some of these advantages are (Kordon):

- Easy to implement.
- Fewer numbers of parameters to adjust.
- Less memory to save (less space complexity).
- Obtained good results in responsible time.

Grey Wolf Optimizer (GWO) is a recently established SI optimization mechanism where their many researchers used it to solve many optimization problems such as Parameter Estimation in Surface Waves (Song, el al., 2015), Economic Emission Dispatch (Song, et al., 2015) and Scheduling problem (Komaki and Kayvanfar, 2015).

The inspiration for GWO is from a species of wolves called the Grey Wolf (Canis lupus), by imitating its hunting methods and hierarchical pack distribution, which are referred to as; Alpha α, Beta β, Delta δ, and Omega (ω); these are used to imitate the series of commands as shown in Figure 2.
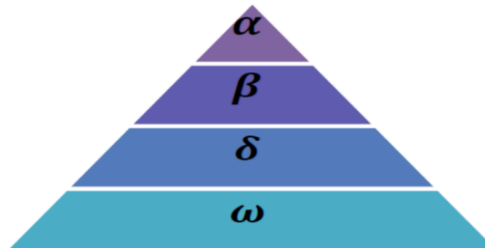

Figure 2. Hierarchy of Grey Wolf (Mirjalili and lewis, 2014)

As seen in figure 2, sovereignty reclines from top to bottom. The first level is Alpha (α), which is the leader, which is not necessary to be the most robust wolf but the superior to other wolves in managing the pack. Thus it is responsible for the decision making. The second level is Beta (β), which helps Alpha in decision making. Thus, it represents as the mentor to Alpha and an educator to the pack. The third level is Delta (δ) which controls Omega (ω). This category could be Scouts, sentinels, elders, hunters, and caretakers. Finally, the fourth level is Omega (ω) that acts as the scapegoat and gives up to all dominant wolves.

In the real world, there are many complicated events that occur simultaneously and in a temporal sequence like weather and galaxy formation, where that far exceeds the capabilities of single-processor architectures (Worboys, 2005).

Therefore, the concept of parallel computing seemed to increase performance and reduce computation time to solve these problems (Barney, 2010) where parallel machines break a single problem in parallel tasks that were performed simultaneously, as TSP problem. Parallel computing is much more suitable for modeling and simulating complex problems (D'Angelo, 2011).

Hypercube is a multi-dimensional mesh of processors with exactly 2 processors in every dimension; this means that a two-dimensional hypercube is made up of processors $p = 2 \char`\^ d$. For example, a zero-size hypercube is a single processor. In general, a hypercube $(d + 1)$ -dimensional is constructed by connecting the corresponding two-dimensional hypercube processors as shown in Figure 3 (Bhuyan and Agrawal, 1984).
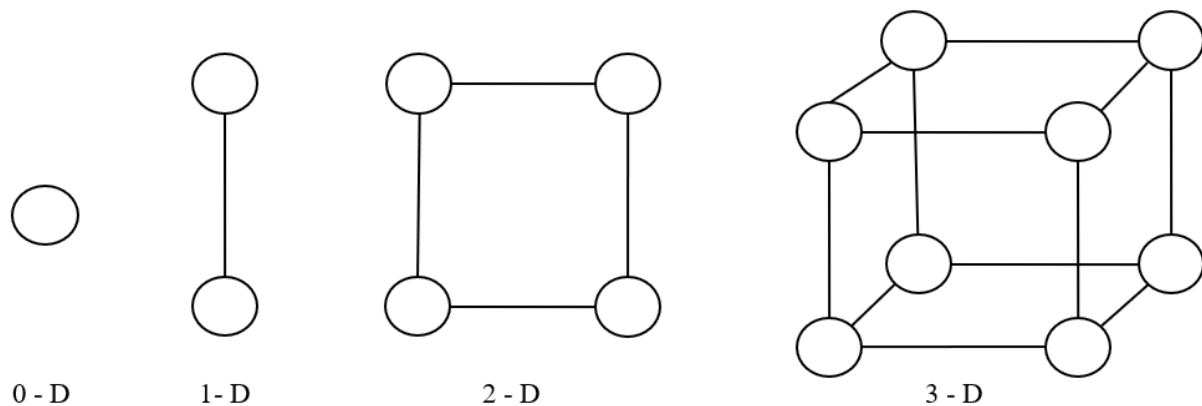
Figure 3. Hypercube Interconnection network

In this study, we decide to use hypercube because of its performance measure proved that it has a better performance compared with static network topologies (Kiasari, et al., 2008) wise of Diameter, Bisection Width, Arc Connectivity and the Cost as shown in Table1. And also, because of the topology of hypercube was implemented in many supercomputers such as Endeavour Supercomputer by NASA (Cathleen, 2011).

The main contributions of this paper are summarized as follows:

- This study adapted GWO to solving the TSP problem, its executed sequentially on different size of World TSP benchmarks and measure the performance in terms of execution time and optimal cost.

- To compare the result of the GWO with other meta-heuristic algorithms, GA (genetic algorithm) and CRO (optimization of the chemical reaction) are chosen and adapted to solve the TSP, the performance metrics are measured in terms of execution times and optimal costs.

- Development of the parallel GWO. The parallel GWO is developed on the basis of both data and computation distribution techniques through the hypercube interconnection network. Data distribution technique is designed based on dividing the dataset map (cities) with a goal of achieving load balancing among the interconnection network. Computation distribution is provided by distributing GWO iterations through the interconnection network to reduce the computing time.

- A comparison between PGOW (Parallel Grey Wolf Optimizer), PCRO (Parallel Chemical reaction optimization) and PGA (Parallel Genetic algorithm) in terms of execution time, parallel runtime, speedup, efficiency and optimal cost. The PGWO shows better performance results than PCRO and PGA.

The remaining of this paper is structured as follows: In Section II, a work related to this study is presented, section III addresses our parallel model for GWO for solving TSP, then in Section IV, the analytical evaluation of the sequential and parallel version of TSP-GWO is presented. Section V shows the discussions of our experimental results. Finally, conclusions and future work are in section VI.

2. Related Works

Several researchers have been conducting research on solving TSP and apply their algorithm on different topologies; below are some of these very recent studies.

A recent meta-heuristic algorithm used to solve TSP in (Kumbharana and Pandey, 2013), where authors used the Firefly Algorithm (FA) to solve TSP problem, the experimental results obtained on different size TSP instances. Authors show that the proposed algorithm provides better results than (ant colony optimization) ACO, genetic algorithm (GA) and simulated annealing (SA) in most of the instances. Also, in (Bhardwaj and Pandey, 2014), they presented a Parallel Ant Colony (ACO) algorithm to solve TSP in heterogeneous platform using the OpenCL framework. All the parameters of the algorithm in ant system are been investigated to their best values as control parameters, where α and β represent the dependency of probability on the pheromone content or the heuristic and equal to $\alpha = 1$, $\beta = 5$ and ρ is the evaporation rate = 0.5. The parallel implementation is done on CPU and GPU using OpenCL, where GPU gives better results. In (AbdulJabbar and Abdullah, 2016), authors proposed a hybrid algorithm based on two metaheuristic methods: simulated annealing (SA) and tabu search (TS). The goal of using tabu search is to resolve the long computation times that take from SA by keeping the best-founded solution in

each SA iteration. By comparing with the basic version of SA, authors found the proposed approach reduces the time complexity by finding the optimal path (best solution) with a few numbers of iterations. In another study (Anjaneyulu, et al., 2014), they used approximation algorithms to find near-optimal solution, the approximation algorithm used for maximization or minimization based on the problem, when it comes to TSP it is minimization. They focused on a special case of TSP, which is Metric TSP (the distance between two cities is the same in each opposite direction), then they proposed a parallel two-approximation algorithm for metric TSP. Finally, they reported that the algorithm found near optimal solution with a significant reduction in runtime. In (Razali and Geraghty, 2011), authors have used the Genetic Algorithm (GA) but with Different Selection Strategies to solve the TSP problem, they firstly use Tournament selection strategy as a popular selection method in genetic algorithm then they try another selection strategy called Proportional Roulette Wheel Selection and as a final selection strategy, they use a Rank-based Roulette Wheel Selection. The algorithms are coded in MATLAB and tested by eight TSP instances. They found that GA with the rank-based roulette wheel selection always gives better solution quality than the other selection strategy.

Because of the importance of TSP and its applications (Applegate, et al., 2007), this study presents a solution to the TSP by using the GWO, where GWO is a recent establish meta-heuristic optimization mechanisms and its success in solving many types of optimization problems with good results. To compare the result of GWO with alternative meta-heuristic algorithms, GWO will be compared with GA and CRO. GA regardless of achieving great success in solving many optimization problems, it is also used for comparison in most meta-heuristic optimization research like in (Shaheen and Sleit, 2016), (Ross and Corne, 1995) and (Ingber and Rosen, 1992). Also, CRO used to compared with GWO because it is one of the newest meta-heuristic algorithm where it also obtained good results in solving NP problems as in (Barham, et al., 2016), (Shaheen, et al.,2018) and (Sun, et al., 1990).

3. Proposed Approach

GWO is a new nature-inspired metaheuristic (Swarm intelligence) where this type of algorithms are inspired by natural systems (Mirjalili, et al., 2014). GWO gets its name from the nature of the social hierarchy of wolves, as well as their hunting behavior. The Hunting behavior of Grey Wolves is split into four procedures: (1) Chasing, (2) Encircling, (3) Hunting and (4) attacking the victim. In Chasing phase, The Algorithm considers that α is the best solution; β is the second best solution and δ is the third best solution. However, ω represents the rest candidate solutions. Thus the hunting is led by the dominant wolves (α, β, and δ). In other words; Grey Wolves could recognize the position of the prey through an iteration process and surround it as in encircling phase, Grey Wolves bounded the victim through the hunt (optimization) by calculating the distance between the location of the prey. In hunting phase, The hunt generally is led be the leader (α). However, sometimes β and δ contribute in hunting. In another hand, there is no idea about the position of the prey that represents the optimum. Therefore, the algorithm assumes that α, β, and δ has preferable knowledge about the position of prey. Thus, the algorithm saves the first three best solutions then update the locations of the rest wolves (ω) depending on the position of the dominant wolves (best search agent) and in attacking phase where it's the final phase, the hunting proceeding obtained the optimization solution the prey stops proceeding.

In this paper, we used the concept of GWO to solve TSP. The proposed solution is implemented in two approaches. In the first approach, the algorithm is implemented sequentially using the standard JAVA programming language where the second approach of the implementation uses Java multithreading and aims to make the most of CPU processing power. The reason for implementing two approaches of the algorithm is to demonstrate the feasibility of the parallel structure. The approaches are implemented in the most logical way possible.

3.1 Sequential ALGORITHM: "GWO-TSP"

In GWO, there are four types of wolfs: Alpha (α), Beta (β), Delta (δ), and Omega (ω) and the prey, wolfs applied the hunting methods to hunt prey, this is being implemented in a hierarchical way until Alpha wolf take the decision of attack. TSP contains number of cities while there is a cost of Travelling between each pair of cities, the objective is to find the shortest path going through all cities, which means a simple cycle tour, which starts and ends at city 1. By applying GWO to find the possible solution for TSP, Figures 4 present the pseudo-code for the proposed "GWO_TSP" sequential algorithm, TABLE 1 shows the main attributes and their meaning related to the proposed algorithm "GWO_TSP", in comparison with wolfs meaning in GWO.

```
Algorithm1: Sequential "GWO-TSP"
Input: TSP problem.
Output : Shortest tour among all cities
1//Initialization phase
2 Population size [].
3 Preys : Initial and next preys selection size = 3;
4 Population [ ].
5 Select 3 random preys from city map and added as initial population.
6    While Population.size < Population [ ] and FullTour(Population [ ]) // Iteration phase
7    {
8             For each Population [i]
9                  Calculate the destination of all wolfs
10        X α = next best wolf from city map.
11        X β = next second wolf from city map.
12        X δ = next third wolf from city map.
13        Update Population as:
14                  Population [i]  =  Population [i] + X α .
15          Population [i+1] + X β  // New population
16          Population [i+2] + X δ  // New population
17        Calculate fitness for each Population .
18   End for
19             If Population > Population.size
20                  Remove most costly tour.
21   End if
22   }
23   return X alpha // final stage
```

Figure 4. Pseudo code of GWO for solving TSP.

Table 1. Profile for GWO-TSP

GOW meaning	GWO-TSP meaning
Gray wolf population	Candidate solution: Tours
Prey	Strat city
Gray wolfs	The remaining cities
Alpha (α) wolf	Nearest city to the start city.
Beta (β) wolf	Second nearest city to the start city.
Delta (δ) wolf	Third nearest city to the start city.
Number of iterations	Number of solutions.
Fitness function	Current optimal TSP solution.

The GWO-TSP algorithm, as shown in Figure 4 (see lines 1, 6 and 23, present these three stages). First, the initialization stage can be shown in Figure 4 (see lines 1-5) to assign initial values for the algorithm parameters. Each individual in the Population is an array, which represents the maximum number of candidate solutions. While each of them consists a full tour as in Table 1. Next, initialize and assign the value of three preys, this is because as the concept of GWO, its assumes that first three wolves (α, β, and δ) has preferable knowledge about the position of prey and as Table 1 each prey represent a city from the city map. Population (see line 4) is an empty array used to constructing the candidate solutions. In order to start building solutions, three preys (or cities) will be selected randomly from the city map (data-set) and added as an initial population where all towns that surrounding them

are considered the grey wolves which is the final step in the initialization stage. The goal of Iteration stage is to generate and build the candidate solutions (or tours) until reaching the best solution. Iteration stage is shown in Figure 4 (see lines 6-22). After generating the three required population as in the initialization stage, each of them will contain a prey that surrounded by a group of wolves. The function (see line 9) used to calculate the destination of all wolfs from the prey then returns the nearest three wolfs from the prey and added to X_α, X_β, and X_δ respectively. Now, based on the positions of the three best wolves, the $X\alpha$ will be added to the original population and two new population will be created and added the prey in each one plus $X\beta$ and $X\delta$ respectively. That's mean, each population will generate two new population and each of them will contain two preys. In other words, after the first iteration, the number of population will be equal nine and each of them will contain two preys. Next, the algorithm will calculate the fitness for each population, which means, the cost of Travelling between cities. While increasing of number of population, the function (see line 20) used to remove the most costly tour. This will happen when the number of population is larger than the allowed population size. Iteration stage keeps working until reaches the stopping criteria, two stopping criteria used to stop the iteration stage. Firstly, the number of population must be larger than the allowed population size, and each population should be contained a full solution. Which means, as equal as the number of cities, this is done through FullTour function. In the final stage, the best solution found will be retrieved.

To understand how this study uses GOW to optimize TSP problem, as in figure 5.a. It shows a TSP problem which is an undirected graph of four cities and six edges, each edge has its own Travelling cost, which will be used in this example to represents the possible solutions. Based on TABLE 1, each element in GWO represent what its means in GWO-TSP, for instance, Gray wolf population in GWO represented in GWO-TSP as the candidate solutions of TSP. By adapting the elements in GWO to our proposed algorithm, The example that was displayed in Figure 5.a this will become as shown in Figure 5.b.
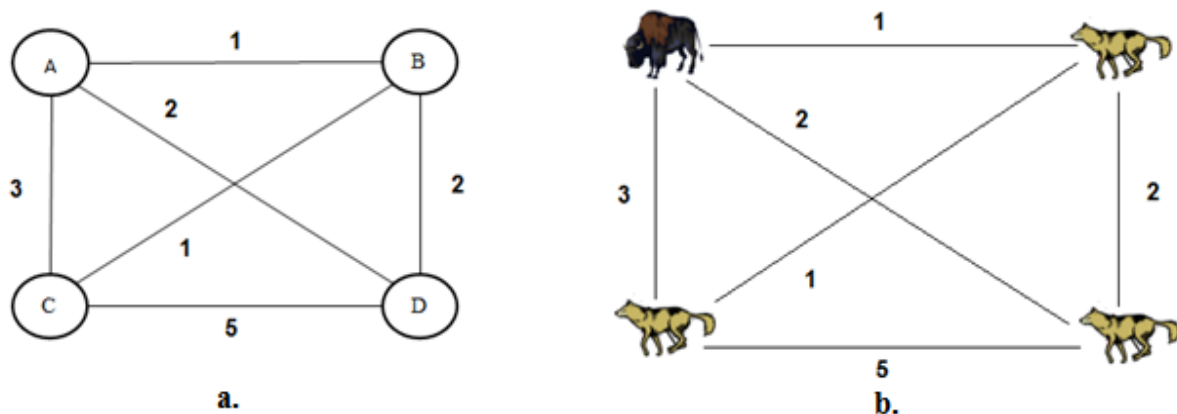

Figure 5. Solving TSP problem using GWO. a) TSP example. b) TSP-GWO example

3.2 Parallel ALGORITHM: "GWO-TSP"

The large number of possible solutions, even with a GWO, opens the possibility of parallelizing the solution for the TSP problem, in which the main objective of this paper is to study the possibility of parallelizing the GWO to solve the TSP problem. In our proposed model, we have created the parallel version of GWO (PGWO) that can be efficiently executed on the Hypercube interconnection network.

For developing PGWO, original TSP map must be divided to achieve load balancing among all processors. In this study, We divide the problem of TSP into sub-problems by creating districts from the original map (dataset) during the partition operation, then we apply the GWO-TSP steps on each part of the district generated by the partition operation. The partition operation consists of two steps:

- Find the highest and lowest values edges of the map.
- Divide the map into multiple districts by subtracting the highest values from the lowest values then dividing the difference by the desired value. Figures 6.1 - 6.3 show how districts are created from a original map.

Figure 6.1: TSP map with group of cities.   Figure 6.2: Find most Top, Bottom, Left, Right cities.   Figure 6.3: Spliting map into number of districts.
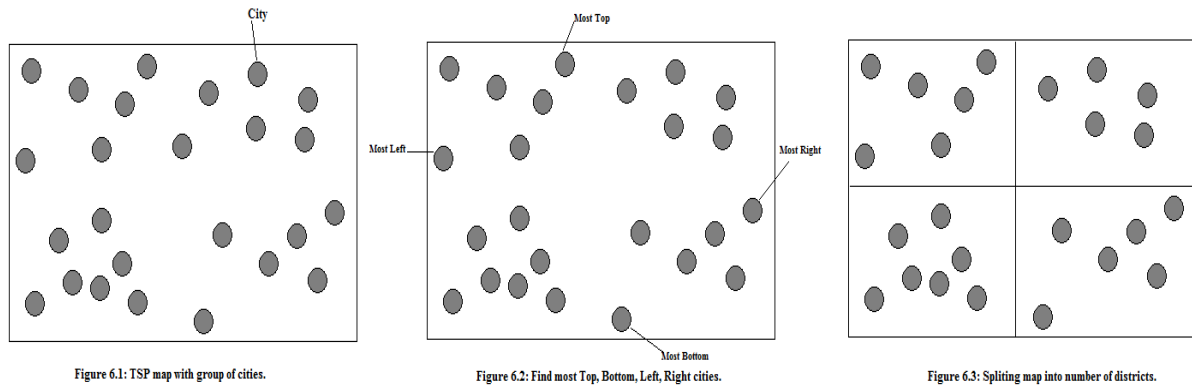
Figure 6. Splitting the TSP map into multiple districts

The number of districts depends on the number of processors we use, for example, if the number of processors is 16, then the number of districts must be at least equal16. The equation 7 was used to find the number of districts.

$$D = N \tag{7}$$

Where D is the number of districts, N is the number of processors. Figure 7 presents the districts algorithm.

Algorithm 2 : Create districts algorithm

Input:

M: map.

N: Number of nodes used to solve TSP using current map M.

Output: D: Array of districts.

1. initial_cities = [ ];

2. MostTopCity, MostBottomCity, MostRigthCity, MostLeftCity.

3. for each city in cities map {

5.   if (city in x-axis is the highest value amongs all cities store it MostTopCity)

6.   if (city in x-axis is the lowest value amongs all cities store it in MostBottomCity)

7.   if (city in y-axis is the lowest value amongs all cities store it in MostRigthCity)

8.   if (city in y-axis is the highest value amongs all cities store it in MostLeftCity)

9. End for}

10. D(Border,CitiesIn) = [ ] where Border: area boundaries, CitiesIn: array of cities in the Border.

11. for each (city in initial_cities) {

12.   for (i = MostTopCity to MostBottomCity) { // increment:= MostBottomCity – MostBottomCity / N)

13.   for (e = MostLeftCity to MostRigthCity) { // increment:= MostRigthCity – MostLeftCity / N)

14. if city x-axis and y-axis between i and y then add city to D with Border i+e .
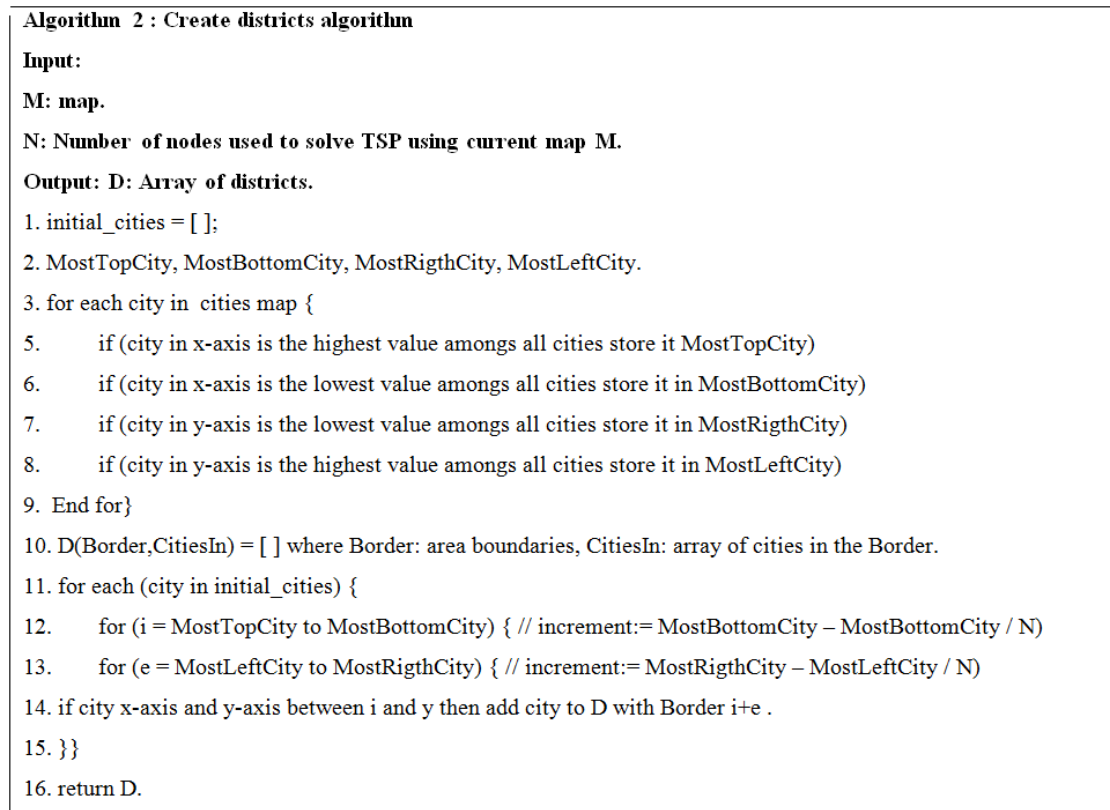
15. }}

16. return D.

Figure 7. Create districts algorithm

As in Figure 7, District algorithm firstly read the city map and add cities on the x-axis and y-axis. Also, find the Border of the map by storing the Most Top City and theMost Bottom City values for x-axis and y-axis. Lines 12 – 15, used to group the cities in districts depends on their location in the map using cities stored in first loop.

As discussed in the introductory section, the hypercube interconnection network contains 2d nodes, where d is the number of hypercube dimension. we can find the number of dimensions of hypercube from the number of nodes using equation 8, where N is the number of nodes.

$$d = \log 2(N) \tag{8}$$

To distribute districts over hypercube, label all nodes in the hypercube interconnection network, where the number of bits is required to label all nodes equal to the dimension value. For example, if the dimension is equal to 3, label all the nodes in three bits (000, 001, 010, ..., 111), which provides eight numbers of nodes. To distribute districts through the hypercube network, find d using equation 8, then check all the nodes. If d = 3, the loop will be executed three times, each time the districts are divided in half and send half to the next node along the dimension (d - 1). Each node, the same operation is performed until it reaches the dimension of d = 0 as an indicator to be stopped (see Figures 9).

Figure 8 shows the routing algorithm for hypercube to partition and distribute the data all over nodes.

Algorithm 3: Hypercube routing algorithm

Input:

D: Array of districts.

doh: Dimension of hypercube.

Output: District partition and distrubtion over hypercube.

1. for (i:=0 to doh) {

2. nextNode = D / 2.

3. SOA(D, 0, part).

4. D = UpdateD(D, part+1, |D|)

5. }
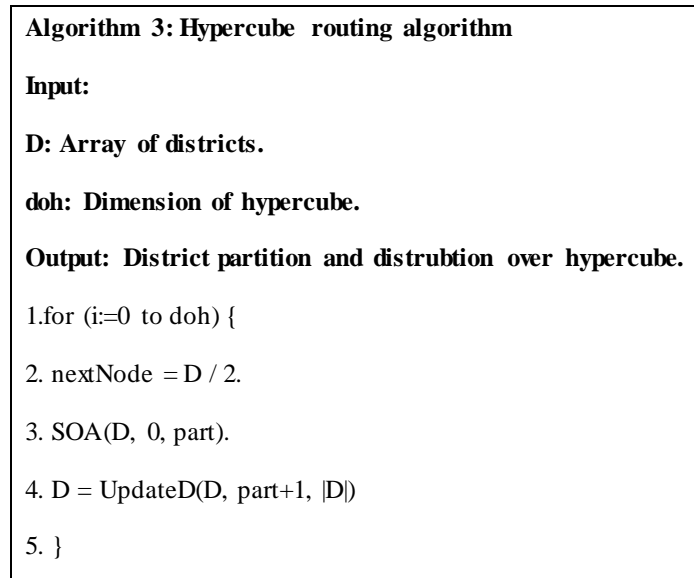
Figure 8. Hypercube routing algorithm

In Figure 8, lines from 1 to 5 a loop equal to the value of hypercube dimension, keeps splitting the districts over all nodes in the hypercube. Line 2 finds the desired value for next node, in Line 3, SOA function responsible to split the original array of districts D, then send that desired value to the next node. Finally, UpdateD function responsible to update the districts array value at Line 4.
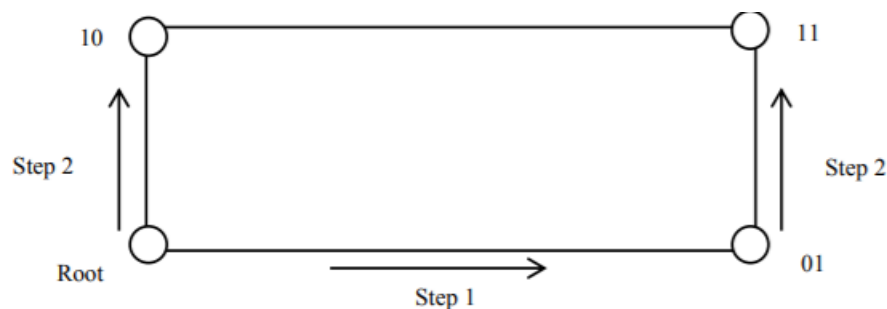
Figure 9 shows the communication mechanism for d= 2.

Figure 9. Communication mechanism over hypercube

The computation distribution is provided by distribution the maximum population size from each district in order to reduce the computation time. As equation 9:

$$\text{population size} = a * \text{districtSize} \tag{9}$$

where a is a factor between [0-1], districtSize equals the number of cities in district and the population size is the

maximum number of candidate solutions.

The data combination is performed by overturning the order of the steps in the distribution phase. After each node completes all the planned iterations, sends the best solution to the node that contains a complete route (shorter path) and links the solution with the solution that it provides, in the end, the master node will contain the final solution (full path). Figures 4 present the pseudocode for the proposed parallel algorithm "GWO_TSP".

Algorithm 4:PGWO-TSP on hypercube interconnction network

Input: TSP problem

Output: Shortest tour among all cities

Phase 1: Load Balancing Phase

1. Root nood applies the Create districts algorithm (Fig. 7) to balance the number of cities among all processors in Hypercube;

Phase 2: Data Distribution Phase

2. apply Hypercube routing algorithm(Fig. 8) to partition and distribute the data all over Hypercube nodes

Phase 3: Local Repetitive.

3 for all processors in Hypercube, do in parallel

4. Apply sequential Grey wolf algorithm(Fig. 4) .

Phase 4: Data Combining Phase

5. for each pair of processors differs only in the dth bit position do in parallel

6. sends the best solution

7. Root processor combines the collected group route and finds the minimum route and its cost.

Figure 10. PGWO-TSP algorithm on the hypercube interconnection network

4. Analytical Evaluation

This section provides the analytical evaluation of the sequential GWO-TSP algorithm in term of time complexity and the parallel version on Hypercube interconnection network in terms of parallel time complexity, speedup, efficiency, and cost.

4.1 Analytical Evaluation of Sequential GWO-TSP Algorithm

As it is described in before, GWO-TSP consists of multiple steps, where initially create initial population then create new generation by Calculating the destination between cities.

All the terms that precede (see line 6) are constants. As shown in Figure 4 (lines 1-5), the outer while loop is expected to run until reach the population size where each population must contain a Full solution, as shown in Figure 4 (lines 2-8). In the worst case, the number of population is equal to the number of cities which means O (n). Inside the main loop, another loop runs equal to population size as shown in Figure 4 (lines 8-18), where in each iteration, three cities are picked and updated the population O(n). The function in line 9 which used to Calculate the destination of all wolfs is require O(n) while line 10 to 16 are constants. In line 17, the time complexity for the function of Calculate the fitness value for each Population is O(n). Variables in lines 17 to 19 are constants.

The total time complexity of sequential GWOTSP is shown in Equation 10 where T is the time complexity, N is the number of population and C is constants:

$$T (N) = O(C + N * (N + C + N + C + N) + C \qquad (10)$$

Equation 10 can be reduced to Equation 11

$$T (N) \quad = O(2C + 3N^2 + 2NC) \qquad (11)$$

The largest term of equation 3 is n^2, Thus, the final time complexity will be O (n^2).

4.2 Analytical Evaluation of GWO-TSP Algorithm on Hypercube

This section provides the analytical evaluation of GWO-TSP algorithm on Hypercube interconnection network in terms of parallel time complexity, speedup, and efficiency.

4.2.1 Parallel Time Complexity

The parallel execution time is equal to the total of computation time plus the total of communication time. The time required to apply the sequential GWO-TSP on a set of cities represents the computation time and the communication time is equal to the number of communication steps required in both phases, distribution and combination.

The analytical evaluation of the complexity of the parallel execution time for all phases of the GWO-TSP algorithm over hypercube interconnection network is demonstrated by tracing the algorithm in Fig. 10, as shown in Table 2.

The overall complexity of the parallel execution time of phases 1-4 is shown in equation (12) where T is the complexity of time, N is the number of cities, P is the number of processors and d is the size of the hypercube.

$$T(N, p) = O(n^2) + O(d) + o(n/p * n^2) + O(d + n) \tag{12}$$

Equation (12) can be reduced to Eq. (13).

$$T(N, p) = O(n^2 + d + n^3/p) \tag{13}$$

Table 2. All phases of GWO-TSP algorithm on Hypercube interconnection network.

Phase 1 (Load balancing phase)	Root processor executes the Create districts algorithm in fig.7. the execution will split the map to a number of districts, from line 1- 3 the time complexity equal to O(5C+1), from line 4-10 the time complexity equal to O(n), finally, the time complexity for grouping cities in districts takes $O(C \times N^2)$, where C is the number of cities in input data and N is the array of districts. The total time complexity is $O(C+n +C \times n^2) \approx O(n^2)$
Phase 2 (Data distribution phase)	In the hypercube interconnection network, the number of steps necessary to distribute the data through all hypercube is required d steps, where d is the size of the hypercube, which is log P, the general execution time is O (d)
Phase 3: Local Repetitive.	All processors run the sequential GWO-TSP on each district. This will require N /P $\times N^2$ time complexity, where N is the number of cities, P is the number of processors and N^2 is the run time complexity of the sequential GWO-TSP.
Phase 4: Data Combining Phase	All processors will send the solution to the root node, this will be performed in log P steps which equals d and root processor required O(n) as time complexity to combining all solutions. The total time complexity is O(d + n)

4.2.2 Speedup

Speedup is an important measure for a parallel algorithm, used to calculate the relation of the sequential computation time and the parallel time as equation 14:

$$S = TS/TP \tag{14}$$

where TS is the time required by the sequential algorithm and TP is the time required by the parallel algorithm.

The sequential time complexity for GWO-TSP is $O(n^2)$ and the parallel version is required which is illustrated in Eq. (3), the speedup of GWO-TSP over hypercube is shown in equation 15:

$$S = n^2 * p / n^2 + d + n^3/p \tag{15}$$

4.1.3 Efficiency

One of the important factors to measure parallel performance is parallel efficiency which measures how much the processors being utilized in the interconnection networks. It is equal the ratio between speedup and the number of processors as equation 16:

$$E = S / p \tag{16}$$

Where E is the Efficiency, S is Speedup as equation 6 and p is the number of processors.

Thus, the efficiency of the GWO-TSP algorithm on Hypercube is shown in equation (17).

$$E = n^2 / \ n^2 + d + n^3/p \tag{17}$$

5. Simulation Results

For our experiments, we used a computer with Intel Core i5-3317U CPU 1.70GHz with 8 GB of RAM. The simulation for GWO, CRO, and GA has implemented in Java JDK 8 programming language. The algorithms were tested by 6 different size TSP problems taken from the World TSP (TSP website, 2009); XQF131, XQG237, PMA343, PKA379, PBL395, and PBN423. The parameters are fixed on follows: number of wolves equals the number of cities in each TSP instance and the maximum number of solutions equals 70% from the number of cities in the dataset, this value is selected to make the algorithm more scalable and to reduce both of computation time and the required space. For fairness, the same specifications and same stopping criteria are used in our simulations for all algorithms.

5.1 Sequential Results

Since GWO, CRO, and GA are meta-heuristic mechanisms, the results obtained in different executions could be different. Because that we repeat the simulation 25 times and record the results as shown in Table 3.

Table 3. The experimental results of sequential GWO, CRO, and GA in terms of fitness value, quality of solution and the execution.

Instance name	Optimal	GWO				CRO				GA			
		Best optimal	Mean optimal	Error rate(%)	Time(Sec)	Best optimal	Mean optimal	Error rate(%)	Time(Sec)	Best optimal	Mean optimal	Error rate(%)	Time(Sec)
XQF131	564	569	575	0.886	22.254	573	580	1.595	17.784	574	591	1.773	18.854
XQG237	1019	1030	1033	1.079	54.985	1033	1037	1.668	44.624	1036	1038	1.766	42.241
PMA343	1368	1385	1387	1.242	68.854	1385	1398	2.119	52.325	1400	1399	2.339	56.745
PKA379	1332	1347	1349	1.126	82.325	1347	1360	1.726	74.365	1358	1361	1.951	72.251
PBL395	1281	1296	1300	1.170	95.254	1296	1312	2.107	83.521	1311	1315	2.341	84.214
PBN423	1365	1383	1386	1.318	112.542	1383	1395	1.831	88.124	1398	1405	2.417	92.248

In Table 3, the first column shows the name of the instance (the numbers in the names indicate the nodes of each instance). The second column shows the best-known solution for each instance taken from the World TSP [42]. For each algorithm there are four columns, the best column shows the best fitness value of the best execution. The mean column shows the average quality of 25 executions of the algorithm. The error rate column shows the fitness function (minimum) of the best individual provided algorithm and the optimal TSPLIB. The error is calculated as in equation 18, finally, the time column shows the time needed to execute the entire program in seconds.

$$Error = \left(\frac{BestSolution - OptimalSolution}{OptimalSolution} \right) * 100 \tag{18}$$

Where Error is the relative value of difference from the optimum tour, Best Solution is the tour length obtained by the experiment and Optimal Solution is the tour length of optimum solution.
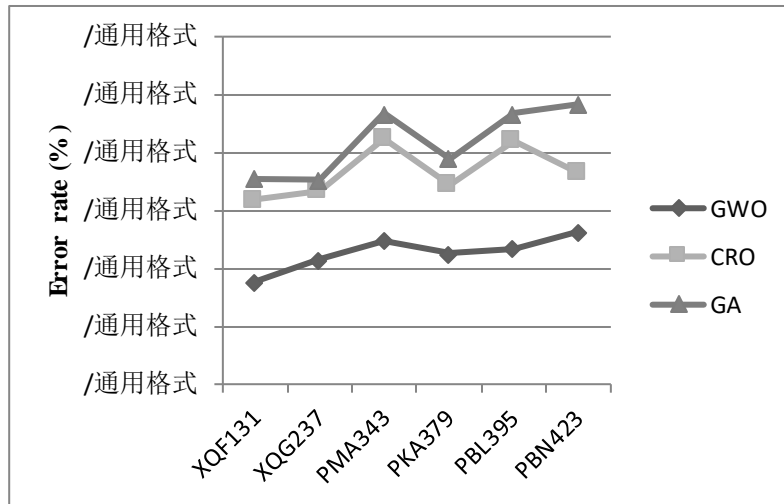
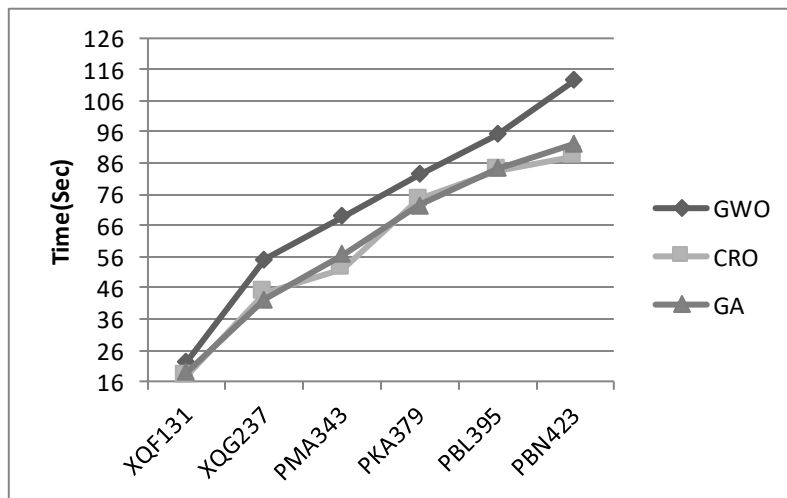Figure 11. Quality of solutions for GWO, CRO, and GA

Figure 12. Runtime chart for GWO, CRO and GA

From Figure 11, it is clear that GOW always gives the highest solution quality (minimum traveling cost) for all TSP instances tested. This is followed by CRO and GA algorithms. However, the quality of solution reduces as the size of instance increase with an increase in execution time for all algorithms.

From Figure 12, we can observe that the runtime for all algorithms is almost the same with a slightly different but the best runtime comes from CRO for some data instance such like PMA343 and PBN423. Also, it is clear that the experimental and theoretical time converge.

5.2 Parallel Results

For the Parallel results, we used a big TSP problem (IRW2802) taken from the World TSP, which contains 8423 cities with 5533 lengths as the known optimal solution.

In Table 2, the first column shows the number of processors, the time column shows the parallel time (best time) it takes to run the entire program in seconds on nodes. The third column shows the Speedup a ratio of the computation time of the sequential time and the parallel time as equation 14. The error rate column shows the error value of the fitness function (minimum) of the best individual as equation 18.

Table 4. Parallel time, Speedup and Error rate for PGWO, PCRO, and PGA.

Num of P	PGWO			PCRO			PGA		
	Time(Sec)	Speedup	Error rate	Time(Sec)	Speedup	Error rate	Time(Sec)	Speedup	Error rate
1	223.42	N/A	5.852	191.58	N/A	8.954	182.54	N/A	9.872
32	10.183	21.942	8.954	9.063	21.138	12.625	10.685	17.083	13.521
64	5.486	40.725	9.715	4.901	39.012	13.851	7.661	23.827	14.841
128	3.614	66.812	11.521	2.508	76.387	14.625	3.704	49.281	16.281
256	**2.335**	95.683	11.842	**2.081**	92.061	15.212	2.898	63.162	15.852
512	**2.298**	97.223	12.945	**2.053**	93.317	17.101	2.487	73.397	18.934
1024	2.817	79.311	14.985	2.963	64.657	19.254	3.603	50.663	21.927
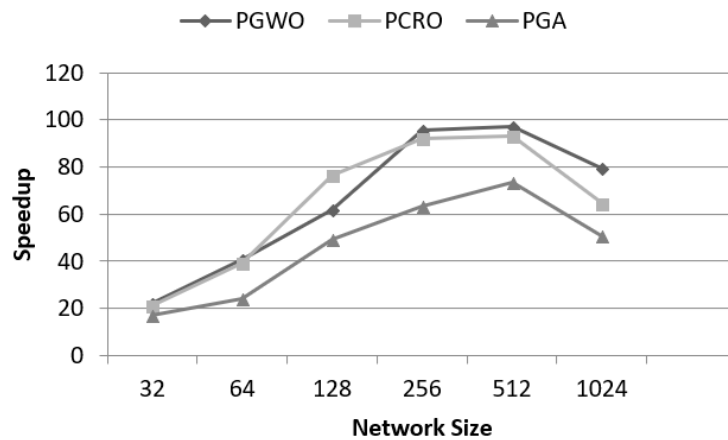
Figure 13. Speedup for PGWO, PCRO, and PGA

Figure 13 shows that speed-up increases in all the algorithms apart from the increase in the number of nodes used until a certain number of nodes begins to decrease. We can see that the speedup is almost linear for PGWO when it uses 32 to 256, while it is sub-linear when there are 512 processors and then begins to decrease. This is due to the communication overload in the 512 and 1024 processors scenario, which is much more than that in 256 processors or less. PCRO got better Speedup compared to PCRO and PGA.
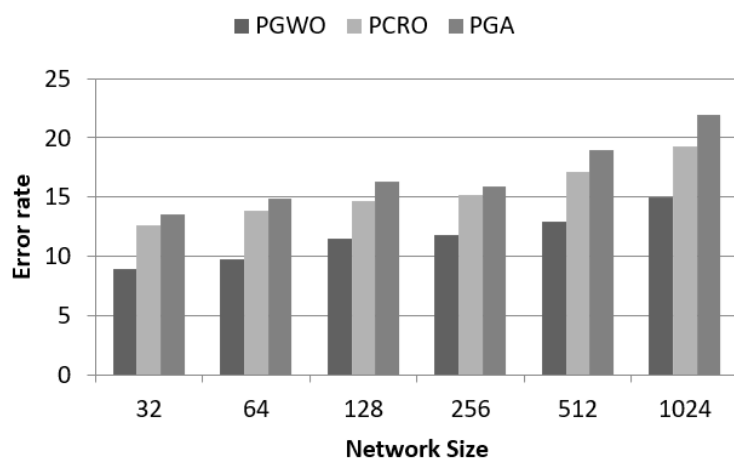

Figure 14. Quality of solutions for PGOW, PCRO, and PGA

Comparing the error rate of fitness values from Figure 14, we find that in most cases the quality of the solutions generated by PGWO is better than PCRO and PGA. This is because in GWO, populations (Solutions) are built from scratch, where the CRO and GA populations are created randomly. The results obtained by CRO are better

than GA, because there are four types of reactions that improve the solutions more than the GA. Moreover, with the increase in the number of processors, the error rate has increased. This is mainly due to the division data and the number of iterations on the processors.
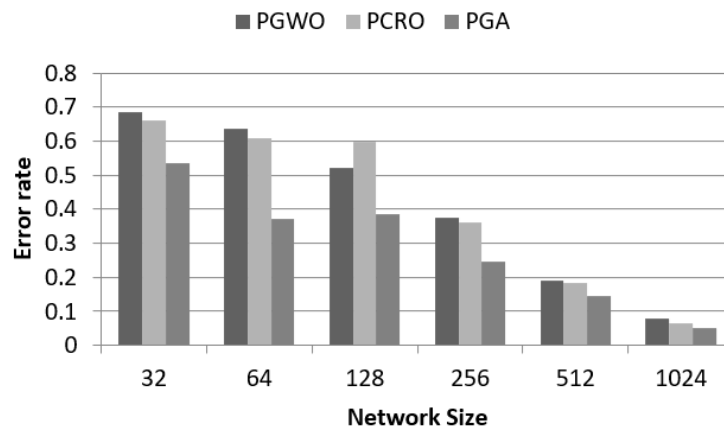

Figure 15. Relative efficiency for GWO, CRO and GA

Figure 15 shows the relative efficiency for PGOW, PCRO, and PGA. As it shows that efficiency decreases in all the algorithms aside with increasing the number of nodes used, since the amount of data shared for each node decreases, so the difference between communication time and computation time is reduced, which affects the speedup. linear with the increase in the number of nodes used, which in turn affects the efficiency, but we can see that the efficiency of GWO is better than PCRO, PGA, where the worst efficiency is obtained from PGA.

6. Conclusions and Future Work

This study introduces a parallel model of GWO algorithm to solve the TSP problem called "GWO-TSP" in a hypercube interconnection network. The analytical evaluation of the sequential and parallel is presented. GWO is compared first with the sequential GWO and then with PCRO and PGA. The simulations are performed by TSP instances of different sizes. To be honest, the same stopping criteria are used in our simulations for all algorithms. The results show that GWO for TSP can improve the fitness value and reduce the computation time with a higher speed-up and better parallel efficiency.

For future work, we intend to compare GWO-TSP with other meta-heuristic algorithms, design and test a deferential interconnection network.

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Change Management in Public High Schools in Jordan, Based on Administrative Innovation principles from the Schools' Principals' Point of View

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Abstract

The study aimed to identify the actuality of change management within secondary schools in Jordan based on the administrations innovative principles. Where the members of the study consisted of (275) public secondary schools principals of both genders, which were chosen randomly. The descriptive approach has been used since it suits the purpose of study, the study found that the level of administrative innovative principles among public high schools principals were low in its four dimensions (originality, fluency, flexibility and sensitivity to problems).

There were statistically significant differences at the level of significance (0.05) in administrative innovation principles related to applying the element of originality with regard to gender, The results showed that there were no statistically significant differences at the level of significance (0.05) in the principles of administrative creativity with its four dimensions attributed to scientific qualification, while it showed that there were statistically significant differences at the level of significance (0.05) in the level of sensitivity to the problems attributed to the experience, The researcher recommended the need for change in the management of public secondary schools in Jordan, based on the principles of administrative innovation.

Keywords: change management, flexibility, innovative management, originality, fluency, sensitivity to problems

1. Introduction

The talk about the importance of developing the leadership role of educational management, in order to bring about the desired changes, a change that is not limited to change this or that administration by changing the administrative units and their organizational structure, but must develop communication patterns, working methods, organizational environment and culture within the institution, by adopting modern management strategies along with their technological dimensions, In terms of systems analysis, informatics, and social dimensions, through the development of human relations, collective leadership, the assertion of democracy, and participation.

High schools in Jordan face many challenges through increasing knowledge, traditional administrative work and various needs in the light of development and progress. Therefore, it was necessary to change its policy and administrative systems and work methods to keep pace with those challenges, which requires the availability of creative skills of high school leaders since creativity is the mean to achieve development and change in those schools.

Managing change is a preplanned structured and organized efforts to achieve the goals of change, through the proper scientific recruitment of the human, material, technical and technological resources available to the educational institution (Emad Eddin, 2003).

A successful manager is the one who seeks to motivate employees to be productive members, Belong to their work, Developed in their information, Independent in their personalities,

The manager must realize that his administrative strength is derived from the strength of the school staff, and he can't be successful and distinct unless he respect their views, recognized their competencies and shared the

vision in the development of the school, empower them in decision-making so that the process of decision-making from the bottom of the pyramid of working faculty members to the top of the administrative staff, led by the headmaster (Darwaza, 2003).

Many creations and innovations had emerged over the ages, most notably the principles of administrative innovation which supported the progress and the development of societies. Since ancient times, societies have developed through the ideas and innovations of thinkers who contributed to the development of societies, during which some of these intellectuals had faced difficulties in introducing their ideas and innovations to the society, since some societies do not accept these new ideas, while insisting on staying in their place, without introducing these ideas and innovations, thinking that such ideas are alien to society and not compatible with their customs and traditions. While there are some who accepted these ideas and contributed to their spread in society. And the question remains; How can these ideas and innovations be mainstreamed into society and how society receive it (Rojers, 2003).

The definitions of creativity have varied and varied, Al-Muhairi (2003) defined it as a flexible scientific imagination aimed to develop an old idea or to find a new one resulting to produce an extraordinary and creative results that can be applied, activated and benefit from. While Guilford (1986) sees it as a set of characteristics that include fluency in thinking, flexibility, originality, sensitivity to problems, redefining the problem and clarifying it in detail.

Administrative innovation was expressed by (Jarwan, 2002) as a combination of capacities, preparations and personal characteristics, which require appropriate management to promote mental processes to lead to authentic and useful products characterized by creativity by focusing on the individual's previous experiences, the experiences of the institution and the world community, it can be defined as a process that seeks to make a distinct shift at the organizational level within the institution by generating creative ideas that are genuine, to be implemented by work individuals and its groups, which has a positive impact on the development of the establishment or the organization (Al-Enezi, 2008).

Nasr (2008) defined administrative innovation in educational institutions as the ability of school administration to acquire creative thinking skills, which can be developed through different methods to develop administrative creativity, in order to create new ideas and methods that help to achieve new administrative processes and introduction of development programs for employees, to stimulate the investment of all their abilities and skills, which enables management to achieve the objectives of the institution.

The need for creativity has been and continues to be the cornerstone in all aspects of life and its problems, but the world today, especially educational institutions, which are more in need of creativity than before; Increasing pressures, and many changes that have been exposed, such as globalization and the knowledge economy, made creativity an urgent necessity for all educational institutions (Jarwan, 2008).

Education in its mission aims at raising the potential of mental and creative abilities of the youth in the education process, trying to direct them to be effective and productive to have a positive impact through diversity, innovation and the development of curricula, that allow all students to progress in areas that tend to like as stated by (Al-Anzi, 2008), where attention shifted from focusing on the physical economy to focusing on the knowledge economy, which depends mainly on developing the creative capabilities of human capital, as well as on speed, imagination, flexibility and innovation (Al-zahry, 2002), Which in turn imposed the need for change and renewal on the educational administration, and focus the attention on creative talents and creative innovation, these elements that represent the basis of the thinking in creative management (Al-Baz, 2000).

The role of administrative leaders in managing educational change processes is one of the inputs that can contribute to determining the outcome of change and highlighting its characteristics. The distinction of any educational system can be attributed to the excellence of the administrative process, and to distinguish human inputs, and enable them to carry out their responsibilities efficiently and effectively and because change is an urgent necessity in life, we need to put into effect an effective law because this change does not always go in the positive direction required. Therefore, the change in its nature is a process of conflict between contradictions; between processions of life, and the back pullers and between the new and the old, And between all the elements of transformation in this life. While change is the result of intentional action, leading to the fact that change is a process, and not an incident, therefore, as a process, it needs the effort, time and programs to create it.

In light of rapid and successive changes in all aspects of life with the emergence of new trends, creative innovations, science and knowledge and New inventions, school principal must adapt to the global, regional and local environment in which he or she is located, through studying the conditions and circumstances surrounding it and anticipating future changes, and looking ahead, through the work of researchers as a university doctor and

a school director, and their observation of high school principals and their relationship to them, change management is of strong importance in our schools and the importance of administrative innovation in the educational work in Jordan, which requires the presence of the creative leader who is able to transform his traditional management into a change management that is compatible with the demands of times.

Therefore, the researchers chose this topic because of its importance in finding a creative leader who can face the challenges imposed on him in this age and raise his school forward.

1.1 Study Problem

The problem of the study is to identify the requirements of change management in public secondary schools in Jordan based on the administrative innovation principles.

1.2 Objective and Questions of the Study

The study aims to identify change management within secondary schools in Jordan based on the principles of administrative innovation by answering the following questions:

1- What is the reality of change management within the public secondary schools in Jordan based on the principles of administrative innovation from the point of view of its principals?

2 - Are there differences with the change at the level of significance ($\alpha = 0.05$) for the reality of change management based on the principles of administrative creativity from the point of view of secondary school principals in Jordan attributed to (gender, academic qualification, years of experience)?

1.3 The Importance of the Study

The importance of the theoretical study stems from:

> • Provide the local community at all levels with results that reveal the extent of activating the principles of administrative innovation in secondary schools in Jordan and their effectiveness in managing the changes.

> • To provide a systematic perspective, which can be used by educational leaders in schools to understand the processes of change in their organizations, which may contribute to reducing the obstacles of change and obstacles to the improvement of organizational effectiveness in different fields of work based on the principles of administrative innovation.

The importance of applied study stems from:

> • Highlighting the management of change, which started to catch attention since the end of the twentieth century, and all educational systems without exception have begun to assimilate, in order to reform their inputs and processes.

1.4 Terminology of Study

The study adopts the following terms:

1.4.1 Change Management

Defined by Emad Eddin (2003) as "managing the planned and organized effort to reach the desired goals of change through the proper scientific recruitment of the human, material, technical and technical resources available to the educational institution."

The researchers defined the process of change management as a process in which a comprehensive plan is designed to bring about changes in the current situation by investing all available resources in the educational institution and in the surrounding environment through developing the vision and the joint mission of the school, Supporting the change and presenting the behavioral model and the intellectual stimulation of the workers until we reach the desired change, and this could be measured by the overall degree obtained by the principals by responding to the paragraphs of the questionnaire.

1.4.2 Administrative Creativity

Defined by Al-Qahtani (2001) as: "the Use of employee personal creative skills, in devising new management methods that lead to innovative solutions to a new administrative problem or new perceptions to address this problem based on objective analysis and structured creative effort related to sensory perception based on analysis, testing, experimentation and evaluation".

The researchers identified the procedural administrative innovation as a: the ability of the school principals to find new ways and methods that stem from thinking and creative abilities of originality, fluency, flexibility, sensitivity to problems, risk, challenge and retention of direction, analysis and linkage in order to improve the

administrative level and keep pace with change, measured by the degree to which principals get from the questionnaire.

1.5 Study Limits

The results of the study can be generalized in light of the following limits:

- **Human Boundaries:** This study was limited to the principals of public secondary schools in Jordan.
- **Temporal and spatial limits:** The results of this study were determined on secondary government schools in Jordan in the second semester of 2017/2018.

2. Previous Studies

2.1 Arabic Studies

The aim of the study of Habil (2008) to see how high school principals in Gaza Governorate practice their role as leaders of change from the point of view of their teachers, the impact of:

Gender, educational area and years of experience) from the point of view of teachers in their practice of managing change, the researcher used the descriptive analytical approach, the study population reached (3234) teachers and teachers, the sample was selected in the random stratified form (328) teachers. The questionnaire was used as a tool to measure the reality of change, the results showed that the degree of principals practicing of change management was 74.6%. The study recommended the adopting of change administration in secondary schools by the Ministry of Education.

While the study of Al-Subaie (2009) aimed at determining the importance of the leadership roles of the principals of education, in light of change management requirements, Degree and feasibility of its use, and the most important obstacles that prevent it, from the point of view of members of the study community, the researcher used the descriptive analytical approach, the study population consisted of all the principals of education and their assistants in the departments of education for boys in the Kingdom of Saudi Arabia which reached (100) persons, and the sample was applied on them. The questionnaire was used as a tool for collecting information, the data were processed using the SPSS statistical program, and the most prominent results of the study were; that the leadership roles of education principals in the light of the requirements of change management is very important from the point of view of members of the study community, and that there are obstacles that prevent the principals of education to exercise their leadership roles in the light of the requirements of change management.

Study of the Al-Ajez and Shuldan (2010), aimed to identify the role of school leadership in developing creativity among secondary school teachers in the Gaza Strip governorates from the point of view of teachers. The two researchers used the analytical descriptive approach to this type of study, The study sample consisted of (303) persons representing (11%) of the original population (3416), the study reached a number of recommendations, including the selection of well-prepared school leaders, who believes in the importance of creativity in the school environment, and seeks to develop it among teachers and learners as well.

2.2 Foreign Studies

The study of Zara and Zadeh (2013) which aimed at understanding the relationship between school administration and the creativity of principals and teachers of public schools in the city of Mahmoudabad in Iran, by using the descriptive approach, the sample consisted of (40) principals and (100) teachers, the results of the study found that the administrative innovation in schools is reflected positively on the performance of principals, teachers and students, the study stressed the necessity to pay extra attention to establish of administrative innovation training programs in secondary schools, due to its positive results on schools educational performance, the study recommended the development of creative thinking for school principals through the use of guidance exercises to increase their problem solving abilities, self-control and attention to issues that lead to the development of Creative systematic thought of the schools principals.

Nwangwa & Omotere (2013) conducted a study aimed at identifying the new roles of high school principals and identifying the impact of change management. The experimental method was used, and the study sample consisted of four randomly selected schools. The results of the study showed that the impact of the implementation of change management in secondary schools has been positive for the development and advancement of the teaching and learning process through the implementation of performance-based management. The results of the study showed that at first there were difficulties in applying change management to the teaching and administrative staff and that required understanding of the new roles of the principals in managing the change.

The Ibrahim and Don (2014) study sought to identify the impact of effective management on the implementation of change management in Malaysian schools. The standard approach was used. The study sample consisted of (342) teachers and principals in secondary schools in the northern region of Malaysia. The results of the study showed that the effective management contributed positively to the implementation of change management in secondary schools. The study showed that change management contributes to the improvement of school performance in general in terms of teachers and students. The results of the study showed also that secondary schools in Malaysia still suffer challenges and difficulties faced by administrators when applying change management. The study recommended that the policy of the State of Malaysia should adopt the change management approach in secondary schools.

2.3 Current Study Site from Previous Studies

By reviewing the previous studies related to the current study, and to identify their theoretical literature and methodology, the two researchers found the following: the studies that dealt with the management of change was important, but these studies did not link the management of change with the administrative innovation principles. In addition the methodological approach in these studies which varied between descriptive based on actual situation and Reality and analytical in addition to the developmental approach.

The researchers noted that there is a series of studies dealing with administrative innovation as synonymous with successful management, as in the study of Al-Ajez and Shaldan (2010). Beside that most studies also recommended that school principals should be pay more attention to creativity and disseminate it among teachers and all staffs in the school, because of its clear impact on the success of the educational institution. The two researchers benefited from previous studies in the preparation of the theoretical framework and enriching it with many ideas related to the creative headmaster and administrative creativity which were the basics that helped them in constructing the study questionnaire.

2.4 This Study is Distinguished from Previous Studies with the Following

This study is distinguished from the previous studies that it dealt with the topic of

Developing the requirements of change management based on the principles of administrative innovation among high school principals in Jordan from the point of view of principals, it was applied in Jordan which was not addressed in any other studies, where most of the previous studies were applied in different societies between Arab and foreign countries.

This study focused on the development of change management requirements based on the administrative innovation principles and this was not dealt with in previous studies.

3. Method and Procedures

3.1 Study Approach

This study is based on the use of the descriptive approach, in order to suit the current study objectives related to "managing change in public secondary schools in Jordan based on principles of administrative innovation" from the principals point of view.

3.2 Society and Study Sample

The study population consists of all (1296) principals of the public secondary schools in Jordan, of whom (567) are males and (729) are females, according to the Ministry of Education statistics for the academic year. The study sample was chosen by random class method from the Secondary schools in the North, Central and Southern Provinces in Jordan totaling (275) schools.

3.3 Study Tool

The study tool was developed to measure change management in public secondary schools in Jordan based on the principles of administrative innovation, from the point of view of schools principals (principles), with reference to theoretical literature and previous studies such as (Al-Ajez & Shaldan, 2010), and (Ozmen and Muratoglu, 2010).

3.4 Study Tool Validity

The study was validated using the method of verifying the content. The scale was presented to the faculty members in the Department of Educational Administration at the University of Jordan, Yarmouk University and Mu'tah university to express their opinions on the validity of the content and the relevance of the phrases to the scale and its suitability to measure what was set for measurement, and then the appropriate amendments were proposed, and a criterion (80%) was adopted to indicate the validity of the paragraph.

3.5 Study Instrument Stability

To verify the stability of the study instrument, the researcher identified the consistency of each paragraph of the scale with the dimension to which the paragraph belongs, using the Cronbach-Alpha- coefficient. Table (1) shows the results of the test.

3.6 Study Variables

The study included **independent variables** that include the administrative creativity principles, namely (originality, fluency, flexibility, sensitivity to problems), **intermediate variables** which include (gender, scientific qualification and experience), in addition to the **dependent variable** that includes change management in public secondary schools.

Table 1. Stability coefficients for study tool paragraphs using the Kronbach Alpha test

Study variables	Study Variables Stability Factor Using Alpha Cronbach
Authenticity	0.87
Fluency	0.76
Flexibility	0.83
Sensitivity to problems	0.81

Table (1) shows that the values of the Cronbach alpha coefficient for the sub-dimensions of the scale ranged from 0.76 to 0.87.

4. Study Results

4.1 Results Related to the First Question

What is the reality of change management within the public secondary schools in Jordan based on the of administrative innovation principles from the point of view of its principals?

To answer the question, Mean and Standard Deviations (SD) were extracted to identify the responses of the study sample members on change management reality within public secondary schools in Jordan based on the principles of administrative innovation from the point of view of their principals as shown on table (2).

Table 2. Mean and the Standard Deviations (SD) of the responses of study sample members on "The reality of change management within public secondary schools in Jordan based on the principles of administrative creativity" arranged in descending order

No.	The principles of administrative creativity	Mean	SD	order	level
1	originality	2.00	0.32	1	low
2	fluency	1.89	0.29	2	low
4	flexibility	1.88	0.33	3	low
5	sensitivity to problems	1.86	0.34	4	low
	Total score of the scale	1.91	0.19		low

Table (2) shows that Mean of (The reality of managing change within public secondary schools in Jordan based on administrative innovation principles), ranged between (2.00 and 1.86), where the element of originality came first, in the last place was the sensitivity component of the problems, All dimensions were within the low level, This finding may be due to the fact that principals do not accept good scientific approach and new ideas on educational issues, and resist change management.

Below is the level of sub-paragraphs for each dimension of administrative innovation principles applied in public secondary schools, which reflect change management in schools.

1- Originality Element Applied Degree

Mean and standard deviations had been extracted from responses of the sample members for the degree of applying the originality component in the public secondary schools. Table (3) shows that:

Table 3. Mean and standard deviations of the responses of the study sample members on paragraphs the degree of application of the originality element is arranged in descending order

No.	Paragraph	Mean	SD	Order	level
4	Respect new views on educational issues	2.20	0.94	1	Low
3	Apply IT for administrative work	2.08	0.92	2	Low
5	Uses appropriate methods to achieve educational policy objectives	2.04	0.93	3	Low
6	Developing self-censorship among teachers.	1.98	0.85	4	Low
1	Accomplish his work in a sophisticated manner	1.94	0.75	5	Low
7	Provides alternatives to new solutions to educational issues.	1.93	0.85	6	Low
2	Apply New methods in the school to solve any problem	1.80	0.68	7	Low
	average Mean	2.00	0.32		Low

Table (3) shows that the degree of (originality element applaied) in the public secondary schools in Jordan from the perspective of its managers is low, Paragraph (4) has the highest mean of 2.20, by standard deviation (0.94), a low level, the paragraph states that the Director (respects new views on educational issues). In the last position, paragraph (2) came with an average of (1.80) and a standard deviation (0.68), where the paragraph states that the Director (applies new methods in the school to solve any problem), this result may be attributed to a lack of respect for new views on educational issues, weak employment of information technology for administrative work and not providing solutions to educational issues.

2- Fluency element Applied degree:

The statistical averages and the standard deviations of the responses of the sample members of the sample were extracted from the applied fluency component in the government secondary schools. Table (4) shows that:

Table 4. Mean and Standard Deviations (SD) of study sample members responses for paragraphs of "fluency element applied" ranked in descending order

No.	paragraph	Mean	SD	Order	Level
2	Seeks to overcome the obstacles to achieving the goals.	2.05	0.89	1	low
1	Has communication skills	1.93	0.78	2	low
6	Brainstorming is used as a means of stimulating thought among teachers.	1.91	0.88	3	low
3	Encourage teachers to discuss and dialogue to find solutions to educational problems.	1.89	0.81	4	low
5	Ask open-ended questions about the problems.	1.85	0.76	5	low
4	He is keen to convince teachers of his views on educational subjects	1.81	0.74	6	low
7	He is keen to express the views of the teachers even if he violates his opinion	1.77	0.73	7	low
	mean	**1.89**	**0.29**		**low**

Table (4) shows that (fluency component applied degree) in Jordan public secondary schools from the perspective of its managers low level, Paragraph (2) has the highest mean (2.05), and with a standard deviation (0.89), which also show low level, the paragraph stated that the Director (seeks to overcome the obstacles to achieve the objectives). In the last rank, paragraph (7) came with an average of (1.77) and with a standard deviation (0.73) which is considered low, where the paragraph states that the director (keen to express the views of teachers even if it violated his opinion). This result may be attributed to that managers do not seek to overcome the obstacles to achieve the goals they planned, and that they do not have adequate communication skills, and that they do not use brainstorming as a mean to stimulate thinking among teachers, this weakens and limits their fluency required to manage change based on the weakness of creative principles in the administrative side.

3- Flexibility Applied Degree:

Upon calculating Mean and Standard Deviations (SD) of the study sample members' responses were extracted from the paragraphs of flexibility component applied in the public secondary schools. Table 5 illustrates :

Table 5. Mean and Standard Deviations (SD) of the study sample members' responses for paragraphs "Flexibility applied Degree" ranked in descending order

No.	Paragraph	mean	SD	order	level
6	Responds to new situations often.	2.18	1.00	1	low
5	Prioritize the implementation of training programs for teachers according to the available resources.	2.00	0.95	2	low
7	Adjusts his position when he is convinced that he is not correct.	1.95	0.73	3	low
4	Assign tasks to teachers according to their specialties	1.93	0.93	4	low
3	Uses a variety of dialogue methods when presented to educational topics.	1.76	0.76	5	low
2	View educational issues from multiple angles.	1.75	0.73	6	low
1	Seeking ideas that contribute to solving work problems	1.59	0.61	7	low
	Mean	**1.88**	**0.33**		**low**

Table (5) shows that (Flexibility component applied degree) within the public secondary schools in Jordan from the principals perspective is considered low. Paragraph (6) received the highest mean at 2.18, and with a standard deviation (1.00), which is also low level, the paragraph stated that the Director (often responding to new situations) came in last position, paragraph (1) came with Mean (1.59) and with a standard deviation (0.61), the paragraph states that the director (seeking ideas that contribute to solving work problems), this result may be attributed to the general decline in response to new positions often by managers, and not prioritize the implementation of training programs for teachers in accordance with the available capabilities as required.

4- The degree of applying sensitivity component to the problems:

The Mean and standard deviations of individuals study responses were extracted from the paragraphs for the component of sensitivity applied degree to the problems in public secondary schools, as illustrated on table (6):

Table 6. standard deviation and means for the responses of study sample members on the paragraphs, the degree of applied sensitivity component to problems "is arranged in descending order.

No.	Paragraph	Mean	SD	Order	level
1	Has a precise vision of the work problems in the educational institution	2.06	0.96	1	low
2	Organize problems according to priorities	1.94	0.86	2	low
7	Searching for creative alternatives to problem solving.	1.91	0.82	3	low
3	patiently deals with the problems he faces	1.85	0.85	4	low
5	Uses scientific thinking methodology to solve problems.	1.84	0.71	5	low
6	Committed to objectivity when dealing with educational problems.	1.84	0.71	6	low
4	Encourages team spirit to solve problems.	1.55	0.60	7	low
	Average Mean	1.86	0.34		low

Table (6) shows that (the degree of sensitivity component applied to problems) in the public secondary schools in Jordan from the perspective of its managers is considered of low level. Paragraph (1) has the highest mean of (2.06) with standard deviation of (0.96) scoring low level, The paragraph stated that the director (has a precise vision of work problems in the educational institution. While paragraph (4) scored last with mean (1.55) and (0.60) of standard deviation, which is still considered low, the paragraph stated that the headmaster encourages team spirit in problem solving. This result may be attributed to the general weakness in having a precise vision of the work problems in educational institutions, while problem solving is not prioritized according to their importance, in addition to the general weakness in the innovative solutions search by managers to solve the problems as they occur.

4.2 Results Related to the Second Question

Are there significant differences at the level of ($\alpha = 0.05$) according to the reality of change management according to the principles of administrative innovation from the point of view of secondary school principals in Jordan attributed to (gender, academic qualification, years of experience)?

To identify the differences in the reality of change management based on the principles of administrative innovation from the point of view of secondary school principals in Jordan, which are attributed to gender and scientific qualification, years of experience variables; having applied the Independent Sample T-test, One Way ANOVA test and Schiffe test; leading to the following results:

4.2.1 First: Gender

Independent Sample T-test was used to identify the differences in the reality of change management based on the principles of managerial innovation from the point of view of secondary school principals in Jordan attributed to gender, table 7 illustrates this:

Table 7. Independent Sample T-test to identify differences in the reality of change management based on the principles of administrative innovation from the point of view of secondary school principals in Jordan, attributed to gender variable

Source	Gender	N	Mean	Standard deviation	T	Sig.
originality element applied	Male	143	2.03	0.31	2.086	0.038
	Female	132	1.95	0.32		
fluency element applied	Male	143	1.89	0.30	0.131	0.896
	Female	132	1.89	0.29		
Flexibility element applied	Male	143	1.89	0.33	0.261	0.794
	Female	132	1.88	0.34		
Apply an element of sensitivity arising from problems	Male	143	1.80	0.34	3.142	0.002
	Female	132	1.92	0.33		
Total	Male	143	1.90	0.19	0.446	0.656
	Female	132	1.91	0.19		

* Statistically functional at the level of significance (0.05) and less.

The results shown in Table (7) that there were statistically significant differences at significance level (0.05), in the reality of managing change based on the principles of administrative creativity on the dimensions; (Applying of originality element and of sensitivity element to problems), from the point of view of secondary school principals in Jordan due to gender. The statistical value of (t) (2.086, 3.142), which are values at the level of significance (0.05) and less, found that the source of differences in applying the element of originality in favor of males. This indicates that male principals apply the element of originality through the use of appropriate methods to achieve the objectives of education policy, and to develop the method of self-censorship of teachers in addition to the completion of the work entrusted to them in a sophisticated manner is higher than females principals, which reflects that female principals need to bring about change management based on the element of originality rather than male managers. The results of the study showed that the source of differences in the application of the sensitivity component of the problems in favor of female managers with an increase in the arithmetic average of the male arithmetic mean, but the overall level was low for females and males, with regard to applying the sensitivity component to problems. This result may be attributed to the fact that female directors are in state secondary schools have a precise vision of the problems of work in educational institutions, The problems are determined by their importance in priority and higher than male managers, because of their high level of sensitivity and are inherently emotional seeking to reduce the problems within the educational institution, which leads to the need to bring change management to male managers more than female directors in this aspect.

4.2.2 Academic Qualification

One Way ANOVA was used to identify the differences in the reality of change management based on the principles of managerial innovation from the point of view of secondary government secondary school principals in Jordan, attributed to the variable of scientific qualification. Table (8) illustrates this:

Table 8. One Way ANOVA Test to learn about the reality of change management Based on the principles **of** administrative innovation from the point of view of secondary school principals in Jordan, attributed to the variable of scientific qualification.

source		Sum of squares	Df	Mean Squares	F	Sig.
Originality	Between groups	0.005	2.000	0.003	0.026	0.974
	Within groups	27.582	272.000	0.101		

	Total	27.587	274.000			
Fluency	Between groups	0.040	2.000	0.020	0.226	0.798
	Within groups	23.798	272.000	0.087		
	Total	23.837	274.000			
Flexibility	Between groups	0.025	2.000	0.012	0.109	0.897
	Within groups	30.716	272.000	0.113		
	Total	30.741	274.000			
Sensitivity	Between groups	0.580	2.000	0.290	2.576	0.078
	Within groups	30.624	272.000	0.113		
	Total	31.204	274.000			
Total	Between groups	0.014	2.000	0.007	0.197	0.821
	Within groups	9.692	272.000	0.036		
	Total	9.707	274.000			

Table (8) shows that there are no statistically significant differences in the reality of change management based on the principles of administrative innovation from the point of view of government secondary school principals in Jordan due to the variable of scientific qualification. (0.109, 2.576, 0.197) respectively, which are statistically insignificant at the significance level (0.05), and the differences between mean, if any, did not reach the level of statistical significance, and this indicates the consensus in the views of secondary school principals to bring about change based on the applying of creativity principles, which suffers from general weakness, regardless of the scientific qualification of the principals.

4.2.3 Experience

The One Way ANOVA test, in addition to Scheffe Test, were used to identify differences in the reality of change management based on the principles of managerial innovation from the point of view of secondary government principals in Jordan, attributed to the experience variable. Table 9 illustrates this:

Table 9. One Way ANOVA Test to learn about the reality of change management Based on the principles of administrative innovation from the point of view of secondary school principals in Jordan, attributed to the variable of experience

source		Sum of squares	Df	Mean Squares	F	Sig.
	Between groups	0.024	2	0.012	0.120	0.887
Originality	Within groups	27.563	272	0.101		
	Total	27.587	274			
	Between groups	0.266	2	0.133	1.533	0.218
Fluency	Within groups	23.571	272	0.087		
	Total	23.837	274			
	Between groups	0.650	2	0.325	2.940	0.055
Flexibility	Within groups	30.090	272	0.111		
	Total	30.741	274			
	Between groups	0.890	2	0.445	3.992	0.020
Sensitivity	Within groups	30.314	272	0.111		
	Total	31.204	274			
	Between groups	0.258	2	0.129	3.709	0.026
Total	Within groups	9.449	272	0.035		
	Total	9.707	274			

The results shown in Table (9) that there were statistically significant differences at (0.05) in the reality of change management based on the principles of administrative creativity related to dimension (sensitivity to problems and total measurement), from the point of view of secondary school principals in Jordan, due to the variable experience, where the (F) (3.992, 3.709, 6.102) respectfully, which are values at the level of significance (0.05) and less, to identify the source of the differences, Scheffe test was used for post-comparisons, were the results are shown in Table (10) below.

The results showed no statistically significant differences at the significance level (0.05) in the reality of change management, based on the principles of administrative creativity related to dimensions (originality, fluency) from the point of view of secondary school principals in Jordan, attributed to the variable experience, with a statistical value of (F) (0.120, 1.533, 2.940) respectively, these values are not significant at the level of significance (0.05) or less.

Table 10. The Schiffe test for post-comparisons to identify the source of differences in the level of sensitivity to problems and overall measurement due to the variable of experience

Dependent variables	(I) experience	(J) experience Years	Mean difference between (I-J)	Statistical significance
		6-10	*-0.11795	0.039
		10 or more	-0.13445	0.077
	6-10 years	Less than 6	.117950*	0.039
		10 or more	-0.01650	0.955
	10 years or more	Less than 6	0.13445	0.077
		6-10	0.01650	0.955
Total	Less than 6 years	6-10	-0.03369	0.424
		10 or more	-*0.08992	0.026
	6-10 years	Less than 6	0.03369	0.424
		10 or more	-0.05622	0.185
	10 years or more	Less than 6	0.08992*	0.026
		6-10	0.05622	0.185

* Statistically functional at the level of significance (0.05) and less.

The results of the Schiffe test for post-comparisons show that the source of differences in the level of sensitivity to problems as one of the dimensions of the principles of administrative innovation, it was for the category of managers with experience (6-10) years the source of the differences in the level of principles of administrative innovation on the overall measurement of principals in government high schools for the benefit of the experienced category (10) years and more.

This result may be attributed to the higher the level of experience of managers the more the level of administrative innovation is increased, calculating the values of the mean, the overall level of managerial innovation was generally low, which calls for change.

5. Recommendations

In light of the results of the study, the researcher recommended the following:

- The need for government high schools to manage change to raise the level of administrative creativity among school principals.

- Work on subjecting the directors of public schools to training courses that increase the level of their administrative creativity related to originality, flexibility, fluency and sensitivity to problems.

- Participating in seminars, conferences and workshops that are concerned with administrative creativity among managers.

- Dissemination of the results of this study to public schools to follow up the level of managerial creativity among principals, and work on the development of future plans to bring about change.

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An Overview of Service Composition in Service Oriented Architecture

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Abstract

Service oriented architecture (SOA) is a form of software design in which application component supply services to other components through a network communication protocol, it has many services that can transfer small data with communication channels or additional services which bring into a relationship that ensure efficiency of service activities, SOA simplify the structure of loosely coupled applicable applications and enable contribution for enterprise working of services together. In order to assure the effectiveness of Service oriented architecture we have to confirm service composition which is the collection of services together in order to perform a specific function which can be used in service oriented architecture. In this paper we proposed a Service composition in SOA, it is present service composition with various techniques used for composing services and provided a comparison between them.

Keywords: service composition, SOA, service oriented architecture

1. Introduction

The development of Internet technology has led to the creation and application of service oriented architecture (SOA) software systems based on application functions in the form of program services to which Access to the Internet or intranet environment of non-depending on the location in the global computer network .Principles of Existing service-oriented-architects do not take into account the functions performed by the services from the features of the model of the problematic and tasks to be solved, the tasks optimal selection of services from a variety of available and their dynamic adaptation to the specific needs, which can lead to the adoption of effective solutions for organizing information processes (Kim and Hwa, 2016).

automation the SOA optimization problem solving to find a solution for it request an efficient methods by software engineers like using search-based software engineering (SBSE) which is a method that perform the optimization techniques of meta-heuristic search-based, we can use Genetic algorithms based on heuristic search to solve optimization problems (Lifang, Wenjian and Hang, 2017).

Service composition represent transferring user functional and nonfunctional requirement to execution plan of service composition as Service Level Agreement (SLA) to detect the services that achieve those requirements, Service Level Agreement can be structure, scenario or optimal execution plan. General directions to companies and individual systems of getting help from external sources tasks build a requirement for automated service composition. a lot of service composition approaches have been presented before, the utilize of AI Planning techniques was firstly introduced lead to two-staged composition, then different approaches presented like workflow-based approach and template-based approach, and more lately service composition approaches in obvious of semantic match emergence service composition development and implementing of Quality of Service (QoS) requirements (Huf, Salvadori and Siqueira, 2017).

This paper is structured as follows: Section II introduces the existing service composition surveys. Section III discusses the service composition techniques. Finally, section IV presents our conclusions

2. Related Terminology

In this section we will illustrate the web service composition, service oriented architecture, dynamic service composition and finally the service composition framework each one of them as a subsection.

2.1 Web Services Composition

A Web service is a network technology that provides program communication (between different applications) based on Web standards. Web-services allow you to access from one application to another and at the same time perform certain functions. The application solution can be a provider of web services or a consumer of web services published by other providers. It is a network technology that provides program communication (between different applications) based on Web standards. Web-services allow you to access from one application to another and at the same time perform certain functions. The Web service has a programming interface, represented in the WSDL (Web Services Description Language) format, a language for describing and accessing Web services, based on the XML language, Designed for unified presentation of external web interfaces (Alessandra et al., 2017) (Hamad, & Adwan, 2018).

FEKIH et al. proposed a new approach based on local consistency build up methods to enhance the skyline approach and to reach the user requirements. The Harmony Search algorithm adopted to catch a near-optimal composition. The experimental evaluation of the proposed approach is reduced the size of classic Skyline in a reasonable time computation (fekih, mtibaa and bouamama, 2017). Also, Elli Rapti et al., adopted the artificial potential fields that can be mapped to the service composition problem in Internet of Thing networks to achieve global equilibrium through local interactions (Rapti et al., 2017). Also, Elli Rapti et al. adopted the artificial potential fields that can be mapped to the service composition problem in Internet of Thing networks to achieve global equilibrium through local interactions (Rapti et al., 2017). Moreover, Yuqian Lu and Xun Xu (217) examines knowledge-based service composition and adaptive resource planning in dynamic cloud environment by developing a systematic and easy to be implement service composition mechanism. They used system utilizes distributed knowledge for intelligent service composition and adaptive resource planning.

Kamath et al. (2013) Recommend a framework that employ A base up methodology to constructing semantic Web services starting with existing service descriptions on the Web, Subsequently decreasing those duration of the time Furthermore cosset included in substantial scale manual annotation.

Figure 2. Shows the web service composition Workflow techniques which classified into orchestration and choreography. In orchestration model, the engaged web services are under control of a single central process (another web service). In choreography model, it does not depend on a central point, all web services should participate. Moreover, in the choreography has to know exactly when to become active and with whom to interoperate (Nagamouttou et al., 2015)
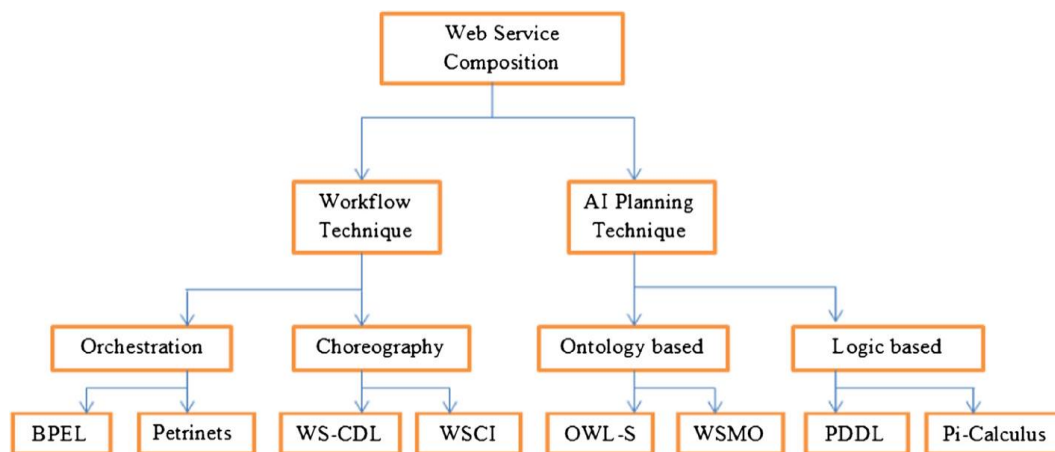
Figure 1. The flow of web service composition

2.2 Dynamic Service Composition

it is the mechanism in which Application services at runtime is connected with a lot of data services, state of being interconnected is deployed dynamically based on the characteristics of database management, for effective data accessing a lot of cloud databases runtime is being provision by connectivity of Data service dynamic and Application service (Li, et al., 2017) (Hudaib &s Fakhouri, 2016).

Wan et al., proposed a novel pattern built element service framework that merge outlined pattern What's more design implementation methodologies to prepare composited services. The pattern may be formalized Likewise an uncommon chart similitude matching issue Furthermore an algorithm may be outlined will figure those

similitude about these services creation results (Wang, Zhitao Wan and Ping, 2017).

Zhang et.al Recommend an algorithm MR-IDPSO (MapReduce according to progressed discrete particle swarm Optimization), which makes utilization of those moved forward discrete particle swarm optimization (PSO) for those Map Reduce should solved extensive scale dynamic service composition. Analyses indicate that our algorithm outperforms the parallel genetic algorithm as far as result of effective vast scale dynamic service composition (Pal, Anshuk Dubey and Sanjukta, 2017).

3. Service Composition Framework

We looked at how to maximize the potential of an SOA solution by identifying business closely connected services framework which is being designed based on work requirements and service contract that the services solution must accomplish, a common framework for service composition system is being listed bellow in figure 1, this framework proposed the fundamentals of service composition methods symmetry and variations (Pal, Anshuk Dubey and Sanjukta, 2017).

The Service composition framework contains the following components: translator, evaluator, process generator, and execution engine and service repository. And have two main participants' service requester and service provider, service requester firsthand participants who suggest the service in order to be used through the framework which provide external specification to the translator (Pal, Anshuk Dubey and Sanjukta, 2017).
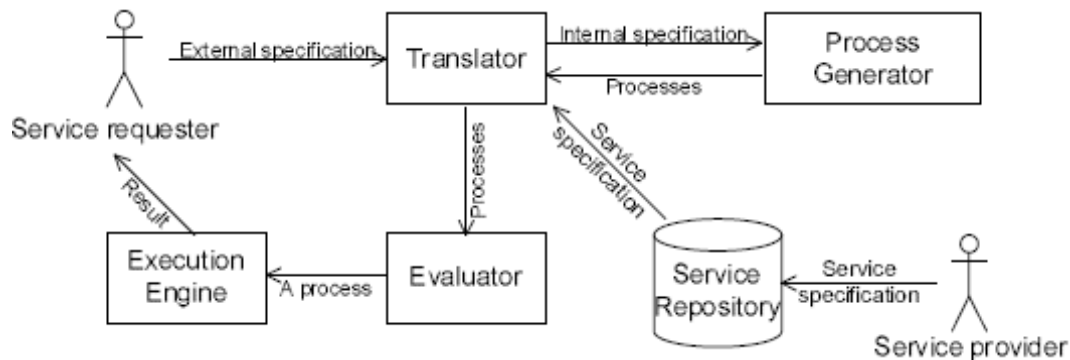
Figure 2. The framework of the service composition system

The service requesters expand service provider's services and data. The translator is a connecter between service provider and process generator to make the language understandable for process generator by translating external specification language used by service requester to the language used by process generator. The execution engine executes the process and plan of data from the evaluator and sends the output to the service requester. For every request translator sends internal specification to process generator. For each request, the process generator produce a plan which control the existing service repository services in order to accomplish the request. If there are many plans the evaluator evaluates all plans and give the leading service for processing (Baldin, Shu Huang and Ilya, 2016)

Service compositions can be classified into primitive and complex variations. In early service-oriented solutions, simple logic was generally implemented via point-to-point exchanges or primitive compositions. As the surrounding technology matured, complex compositions became more common see figure 4.

Much of the service-orientation design paradigm revolves around preparing services for effective participation in numerous complex compositions. So much so that the Service Compensability design principle exits, dedicated solely to ensuring that services are designed in support of repeatable composition.
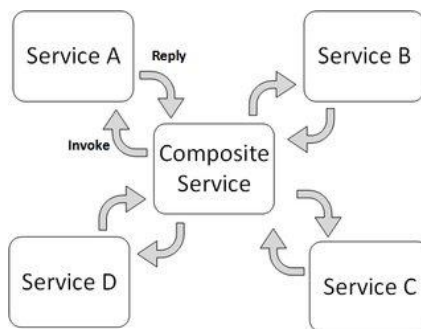
Figure 4. Service composition communication

4. Service-Orientation and the Concept of "Application"

Service-orientation places an unprecedented emphasis on reuse. By establishing a service inventory with a high percentage of reusable and agnostic services, we are now positioning those services as the primary (or only) means by which the solution logic they represent can and should be accessed.

As a result, a very deliberate move away from the silos in which applications previously existed. Because we want to share reusable logic whenever possible, we automate existing, new, and augmented business processes through service composition. This results in a shift where more and more business requirements are fulfilled not by building or extending applications, but by simply composing existing services into new composition configurations (Al-Sayyed et al, 2017).
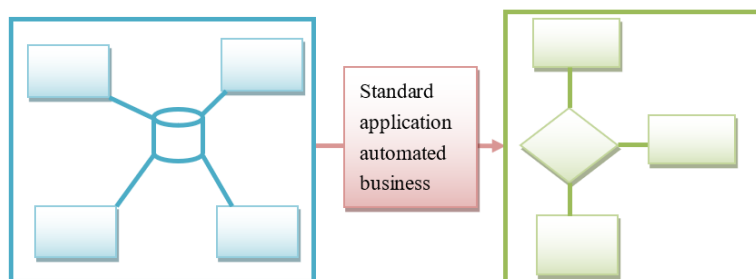
Figure 5. The traditional application, delivered to automate specific business process logic

When compositions become more common, the traditional concept of an application or a system or a solution actually begins to fade, along with the silos that contain them. Applications no longer consist of self-contained bodies of programming logic responsible automating a specific set of tasks. What was an application is now just another service composition. And, it's a composition made up of services that very likely participate in other compositions (Al Khattab et al, 2015).

Table 1. Service composition approaches according to each researcher and the techniques used

Composition approaches	Researcher	techniques
Meteor-s	Aggarwal et.al(2015)	Present demand Web Service Composition composition device in METEOR-S,which permits those transform designers on Web benefits with a conceptual process, In view of business and procedure imperatives What's more produce an executable procedure.
		Approach may be to decrease a great part of the Service Composition issue will a demand fulfillment issue. It utilization A multi-phase methodology to demand dissection. This worth of effort might have been done Similarly as and only the METEOR-S framework, which plans on backing the complete lifecycle from claiming semantic Web forms.
Sword		
	Asmethal	Recommended Web service framework is used to give services in an ideal way.

	et.al(2012)	In the suggested structural engineering five levels are utilized. Benefits need aid made independently with those help of a toolkit thus those seniors could select their service effectively. Web service Adapters need aid utilized for conveying for a few Web services. It may be necessary for build the composite benefits manually. This will be particularly vital on account of composite service formation may be not so much a one-time exertion.
Wsmo Template based composition	Siddiqui et.al(2012)	Proposes the template-based composition which parts the determination and composition methodology the middle of two phases. Format built composition employments design-time will request those placeholders Furthermore to join them, Furthermore utilization run-time will fill the placeholders for those real execution.
Shop2	Parsia et.al(2013)	Depicted actualized framework which performs translation, employ a developed SHOP2 usage on arrange for What's more over the translated domain, et cetera executes those coming about compositions. In the methodology about characterizing the interpretation Furthermore building those framework, present approach, the organizer constantly executes yield handling activities Concerning illustration its compositions. Same time this is fine to huge numbers situations, it might not continuously make suitable.
Star WSCop		
	KASSMI et.al(2016)	Recommend in compositions for security prerequisites. It comprises on demonstrating some security necessities utilizing FSM (Finite state Machine) Furthermore their mix rapidly with communicated utilitarian prerequisites. On accept our formalization What's more mix approach clinched alongside web service composition, we bring utilized model checking apparatus UPPAAL.
Web service	Bartalos et.al(2011)	Suppose that service composition to be examined likewise from programming building purpose from claiming perspective. A technique must make produced describing the methodology about Web service design, semantic annotation, maintenance, and the use about Web service composition. Devices supporting these assignments must make Gave. Currently, it will be not clear for which path is it useful with misuse service creation. We don't recognize On it to be connected best to other domains, if we by any means might successfully utilization state funded services or must depend looking into private ones main. Exploration consideration if make committed should discover An executioner provision demonstrating to those reductions and limits about service composition On act.
SECSE		
	Wang et.al(2011)	Identify the challenges around service compositions: evolving execution contexts, self-adaptation during runtime, and the workload about service suppliers. With face of these challenges, they configuration and execute An self-adaptive Also context-aware service composition system, which might tackle setting occasions Also settle on changing adaptations as stated by user-defined customize strategies.
QoS		
	Paik et.al(2009)	Suggested adjustable transaction What's more QoS-aware service Choice approach under five client custom settings In light of hereditary calculation (GA) on deliver over worries. QoS-awareness encouraged Eventually Tom's perusing multi-objective QoS criteria Also ga is utilized to multivariate streamlining. We led An careful evaluation, Also it reveals to suggested technique viably Also effectively scope the worldwide ideal of the generally determination criteria.

5. Service Compositions and Technology Architecture

Because applications have existed for as long as IT, when technology architecture as a profession and perspective within the enterprise came about, it made perfect sense to have separate architectural views dedicated to individual applications, integrated applications, and the enterprise as a whole.

When standardizing on service-orientation, the manner in which we document technology architecture is also in for a change. The enterprise-level perspective becomes predominant as it represents a master view of the service inventory. It can still encompass the traditional parts of a formal architecture, including conceptual views, physical views, and supporting technologies and governance platforms - but all these views are likely to now become associated with the service inventory (Hudaib et al, 2016).

A new type of technical specification that gains prominence in service-oriented enterprise initiatives is the service composition architecture. Even though we talk about the simplicity of combining services into new composition configurations on demand, it is by no means an easy process. It is a design exercise that requires the detailed documentation of the planned composition architecture.

For example, each service needs to be assessed as to its competency to fulfill its role as a composition member, and foreseeable service activity scenarios need to be mapped out. Message designs, messaging routes, exception handling, cross-service transactions, policies, and many more considerations go into making a composition capable of automating its designated business process.

6. Conclusion

The number of publicly accessible service composition techniques and approaches are growing, so we see a fast improvement in service composition technologies this survey presented based on different techniques like Automated based service composition, Process algebra base service composition, or Petri Nets based service composition. Most of service composition techniques are automated and web based service composition in regards to its privileges in the comparisons with other techniques to enhance the achievement of composition objectives. Our future work is to assess the possibility and additionally those points of interest about the feasibility as well as the advantages and disadvantages of different service composition approaches.

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Rehabilitation of Reinforced Concrete Deep Beams Using Carbon Fiber Reinforced Polymers (CFRP)

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Abstract

Reinforced concrete structures that incorporates deep beams are generally susceptible to deterioration due to weathering effects and sulphur attacks, under-design in the detailing of concrete cover and/or reinforcement, and construction errors. In lieu of demolishing and replacing these structures, rehabilitation and strengthening using carbon fiber composites becomes a cost-effective viable alternative. Recent advances in research and innovation have introduced concrete repair and strengthening systems that are primarily based on fiber reinforced polymer composites. These systems have offered engineers the opportunity to provide additional stability to the structural elements in question and to restore the damaged portions back to their original load carrying capacity.

This paper investigates the effect of Carbon Fiber Reinforced Polymer (CFRP) composites in enhancing the flexural performance of damaged reinforced concrete deep beams. Two types of CFRP composites and epoxy were used in the experimental investigation carried out and as described by this paper: 1) high strength carbon fiber reinforced polymer (CFRP) plates, commercially known as MBrace Laminate, that are bonded using an epoxy resin specifically suited for the installation and used to strengthen existing structural members; and, 2) MBrace Fiber 230/4900, a 100% solids, low viscosity epoxy material that is used to encapsulate MBrace carbon, glass, and aramid fiber fabrics so that when it cures, it provides a high performance FRP sheet.

Test samples were divided into four groups: A control group, and three rehabilitated test groups with CRFP fibers, where the main variable among them was the percent length of CRFP used along the bottom beam extreme surface between supports (i.e, for two of the groups reinforced with MBrace laminates), and the use of MBrace Fiber 230/4500 CRFP sheets on the 4th beam along its vertical sides as well as the bottom extreme face between supports. All beams had similar cross-sectional dimensions and reinforcement, and were designed to fail in flexure rather than shear.

The results show that CFRP composites, both laminated and sheet type, have increased the load carrying capacity in comparison to the control specimen, where observations were recorded pertaining to the delayed formation of vertical flexural cracks at the section of maximum moment, and diagonal shear cracks at beam ends. The increase in the load carrying capacity varied among the three rehabilitated test group beams, with the 4th group showing the highest ultimate load carrying capacity when compared to the control specimen.

Keywords: deep beams, CFRP, flexural strengthening, laminates, sheets

1. Introduction

Reinforced Concrete Deep Beams (RCDBs) are considered one of the most important structural elements in civil engineering practice and are widely used in different types of structures, such as tall buildings, offshore structures, foundations, bridges, transfer girders, and shear walls (Al-Sarraf et al., 2011; Attarde and Barbat, 2015; Attarde and Parbat, 2016; Kong, 2006; and Suresh and Kulkarni, 2016).

Deep beams are popular for the structural horizontal elements of long spans where the number of intermediate supports are limited by architectural or navigational reasons. Because of the low span to depth ratio of deep beams when compared to normal flexural elements, Hooke's Law which states that plain sections remain plain

before and after bending no longer holds, and their analysis, design, thereby further complicating design and detailing. As a result, the significance of shear deformations in deep beams become more pronounced when compared to their shallow counterparts (Al-Sarraf et al., 2011; Attarde and Parbat, 2016; and Nawy, 2009).

For deep beams built outdoors, deterioration and loss of member carrying capacity can result from exposure to detrimental environmental conditions during their service life, under-design, incorrect construction practices, or even the desire to increase the load carrying capacity of a perfectly sound structural system (David et al., 1998). Cracking and spalling of the concrete cover is considered one of the most primary reasons for the deterioration phenomenon, as cracking and spalling will cause loss in carrying capacity as well as allow for corrosion and exposure to adverse environmental conditions long term (Ahmad, et al., 2012; and Kim and Yun, 2011).

Several techniques have been reported in the technical literature, including the injection of polymer modified mortar (PMM) into the cracks in normal beams (Ahmad et al, 2012), or, in the case of deep beams, the use of external carbon fiber reinforced polymer (CFRP) (Obaidat et al, 2011), as well as the use of unbonded post-tensioned carbon fiber reinforced polymer rods (Burningham et al, 2015).

For deep reinforced concrete beams when compared to regular shallow beams both having the same shear and flexural reinforcements, shear failure is most likely to occur in deep beams rather than in regular beams. Thus, retrofitting of deep beams with shear deficiencies using externally bonded reinforcement such as carbon fiber reinforced polymer (CFRP) becomes an excellent solution. The advantages of using CRFP are numerous and include their relatively high tensile strength, lightweight, excellent corrosive resistance, high durability, ease of installation, and above all, the significant increase in the flexural and shear load carrying capacity of the structural member once the CRFP fibers are bonded to the exterior surface of the deep beam members (Ahmadi, 2013; Ali et al., 2013; Benjeddou et al., 2007; David et al., 1998).

This investigation deals with the use of CRFP fibers in full or partially along the extreme bottom concrete surface of the deep beam, as well as investigating the effect of using U type jacketing along the beam sides and extreme beam surface. The investigation compares the load vs. deflection relationship of the CRFP strengthened beams relative to the control beam and analyses the development of crack location and width along the members, with special emphasis on the type of failure at ultimate nominal resistance (i.e., pure flexure, pure shear, or flexural-shear).

2. Experimental Program

Experimental tests were conducted on a series of ten simply supported RCDBs under one concentrated load to investigate the use of externally bonded CFRP to restore and repair damaged RCDBs. Construction of all the test specimens was conducted according to ACI318M-14, ASTM C293-02 and ACI 440.2R-08 specifications.

Tests were carried out for:

1 Undamaged reinforced concrete deep beams subjected to one concentrated load (control specimens).

2 Damaged reinforced concrete deep beams to 60% of average ultimate load of control beams; then rehabilitated with CFRP and subjected to one concentrated load.

The test specimens were divided into four groups: a control test group and three rehabilitated test groups with CFRP fibers. Table 1 summarizes the details of each test specimen.

Table 1. Details of the test specimens

| Group Name	Description	Specimen Designation	Rehabilitation Details		Fibers Orientation	Place of Test
			CFRP material	Rehabilitation Scheme		
Control Beam	Two Control Beams	CB1	-------	---------	--------	JU* / Concrete Lab
		CB2	-------	---------	--------	JUST**/ Structural Lab
Group I	Three Rehabilitated Beams	RB1-1 RB1-3 RB1-2	Laminate	Two strips of laminate covering the full width of the beam between the supports	0^0	JUST**/ Structural Lab JU* / Concrete Lab
Group II	Three Rehabilitated Beams	RB2-1 RB2-3	Laminate	Two strips of laminate covering the full width of the beam with a total	0^0	JUST**/ Structural Lab

					length of 800 mm		
			RB2-2				JU* / Concrete Lab
Group III	Two Beams	Rehabilitated	RB3-1 RB3-2	Sheet	One layer of CFRP Sheet with U-Shape (covering the full width of the beam between the supports and covering half depth 250 (mm) from both sides of the beam	0^0	JUST **/ Structural Lab

*JU: The University of Jordan.

**JUST: Jordan University of Science and Technology.

2.1 Test Specimens

All tested RCDBs had cross-sectional dimensions of 200 mm width, 500 mm depth and 1800 mm length. The ten test specimens were designed to fail in flexure rather than shear. Design of test specimens was according to ACI318M-14, ASTM C293-02 and ACI 440.2R-08 specifications. The type of reinforcement used in this test for all test specimens was high yield strength deformed bars of grade 60 (ksi) which have minimum yield strength of 420 (MPa). Two type of deformed bar reinforcement were used in RCDBs; and they are 2Φ14 as minimum longitudinal top and bottom reinforcement; 25Φ12 closed stirrups and three layers of 2Φ12 as horizontal reinforcement. Dimensions and reinforcement details of test specimens are illustrated in Figure 1.

Longitudinal Section in Beam Reinforcement Detail

Section (A-A) Reinforcement Detail

Stirrups Detail

Section (B-B) Reinforcement Detail
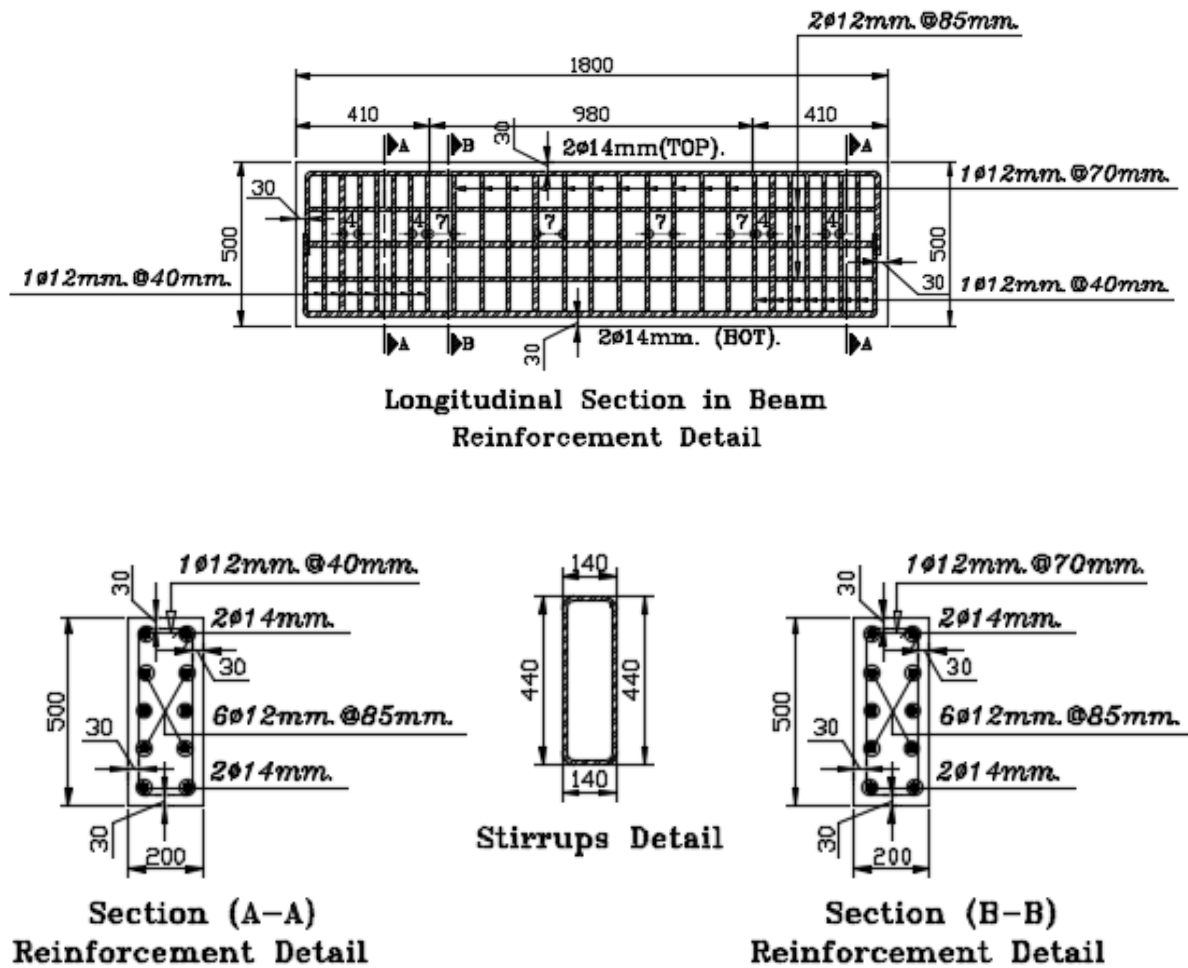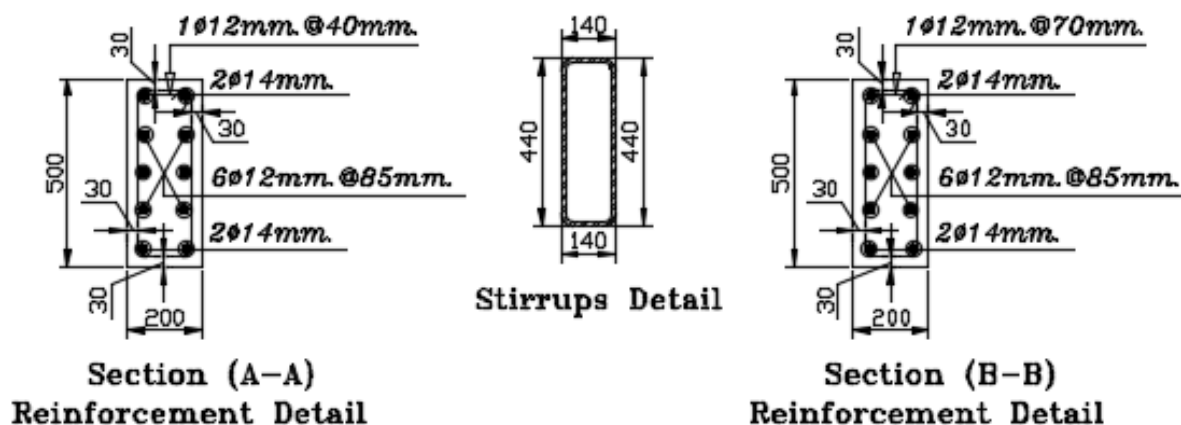
Figure 1. Dimension and Reinforcement Details of Test Specimens

(All dimensions are in millimeters)

A ready mix concrete with an average value of cubic compressive strength 23.8 (MPa) was used for casting the RCDBs.

2.2 CFRP Material and Rehabilitated Schemes

During the investigation of this study, two types of CFRP and epoxy resin were used during the rehabilitation procedure and they were MBrace Laminate with MasterBrace ADH 2200 and MBrace Fiber 230/4900 with MasterBrace SAT 4500. Typical properties of the CFRP materials are illustrated in Table 2.

Table 2. Typical Properties of MBrace Laminate and MBrace Fiber

Property	CFRP Material	
	MBrace Laminate	MBrace Fiber 230/4900
Fiber Tensile Strength (MPa)	>2.80	4.9
Fiber Design Thickness (mm)	1.4	0.166
Width of Fiber (mm)	100	500

As a first step in rehabilitation procedure, all RCDBs were cleaned from any improper things like dust, laitance and loose material with a suitable sandpaper followed by washing them with water and then drying to ensure that RCDBs were clean. The next step was painting the required surface of RCDBs with a thin layer of epoxy resin approximately 3 mm followed by attaching CFRP laminate or sheet according to the adopted scheme and finally painting another layer of epoxy resin onto the CFRP with adequate pressure by a suitable hammer to remove any entrapped air bubbles. The RCDBs were cured for a minimum period in winter of fourteen days at room temperature. Epoxy is considered an essential part during rehabilitation procedure; for this reason two types of epoxy were used for CFRP material to avoid any debonding between the concrete surface and CFRP. Both types of epoxy resin in this study consisted of two components; a resin and a hardener. Both types of CFRP materials and Epoxy resin are shown in Figure 2.

Mbrace Laminate　　　MasterBrace ADH 2200　　　MBrace Fiber 230/4900　　　MasterBrace SAT 4500

Figure 2. Types of CFRP Materials and Epoxy Resin

The second and third test groups were enhanced with two strips of MBrace laminate (each strip 100 mm wide) bonded externally to the bottom side of the beam and covering the full width of the beam between the supports in the 2nd test group and with a length equal to 400 mm from left and right side of centre line of the beam in the 3rd test group (i.e. with total length equal to 800 mm), while 4th test group was enhanced with a U-shape of MBrace Fiber 230/4900 covering full width of the beam between the supports and covering half of the depth from both sides of the beam. Schemes of CFRP materials of three rehabilitated test groups are illustrated in the Figure 3.

Section (A–A)

Section (B–B)

(RB1-1, RB1-2 and RB1-3)

Section (A–A)

Section (B-B)

(RB2-1, RB2-2 and RB2-3)

Section (A-A)

Section (B-B)

(RB3-1 and RB3-2)
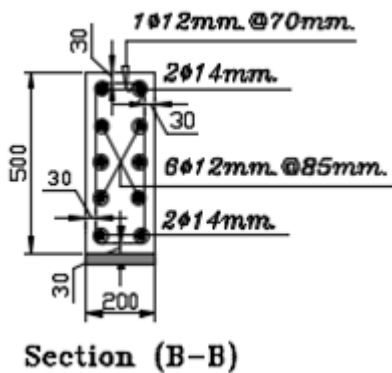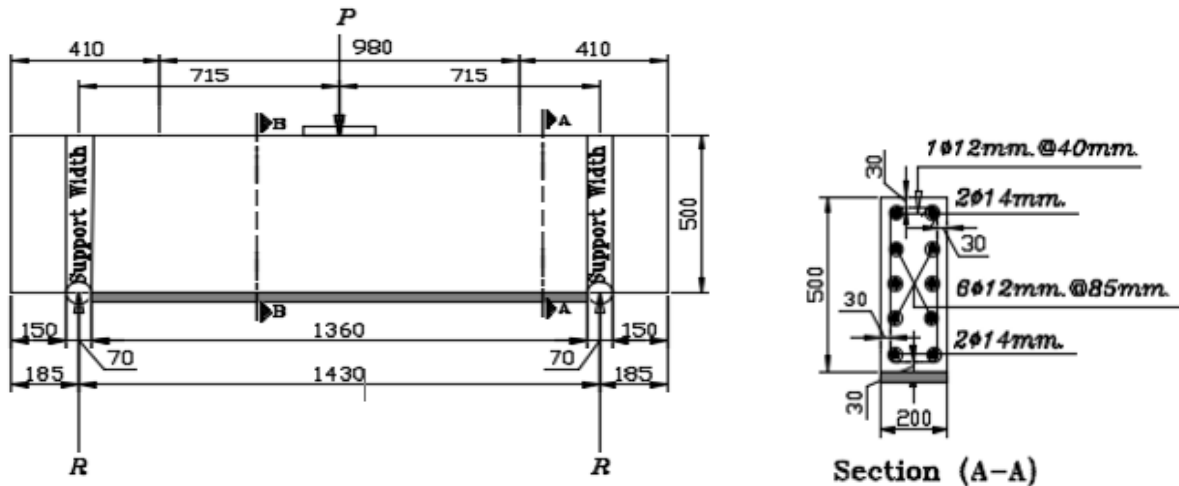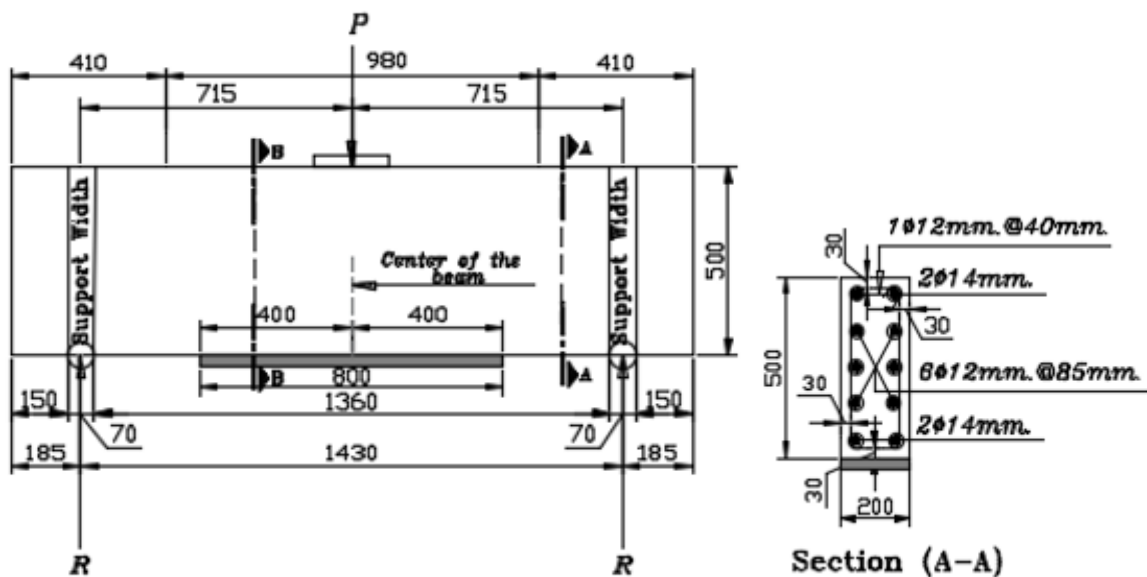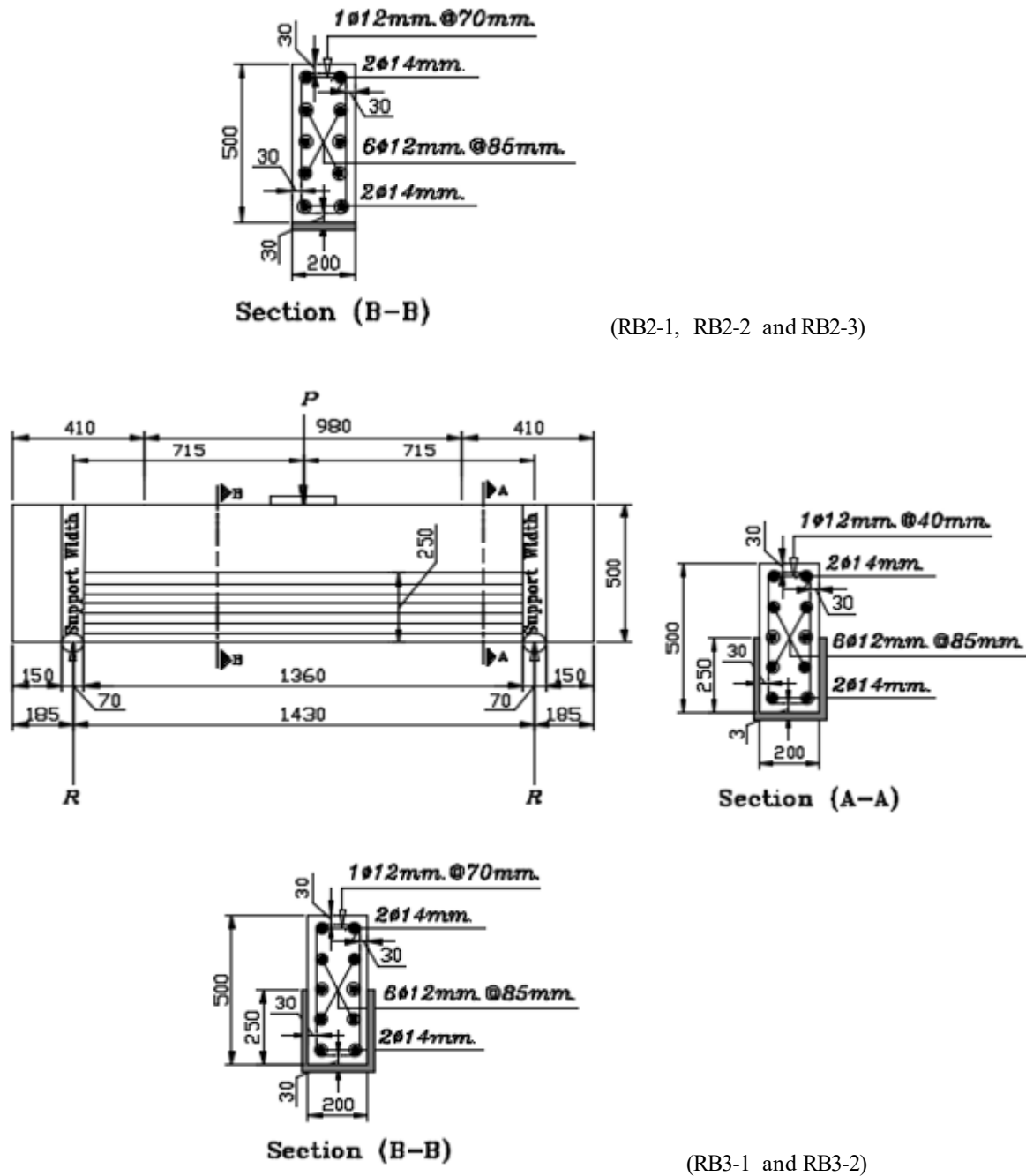
Figure 3. Schemes of CFRP Materials for Rehabilitated Test Groups

(All dimensions are in millimeters)

2.3 Experimental Setup and Procedure

Some of the specimens were tested in the concrete lab at the University of Jordan (JU) and due to a technical problem with the testing machine; the remaining specimens were tested in the structural lab at the Jordan University of Science and Technology (JUST). All RCDBs were tested under one concentrated loads at both universities. Different loading rates were used during the test at both universities and they are as follows:

A. 2.5 kN/second at University of Jordan in concrete lab.
B. 2.0 kN/second at University of Jordan in concrete lab.
C. 0.5 kN/second at Jordan University of Science and Technology in structural lab.

Figure 4 illustrates test setup of specimens at both Universities.
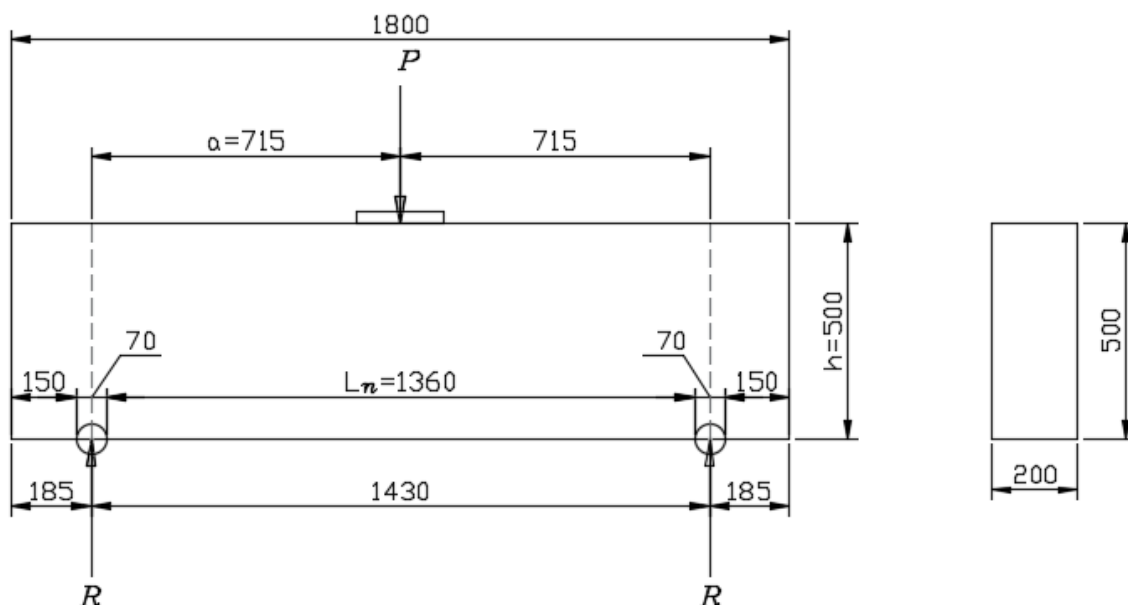
Figure 4. Test Setup (all dimensions are in millimeters)

During testing procedure, vertical mid-span deflection as well as formation of cracks with their propagation were recorded at each loading stage.

3. Results and Discussion

In the following sections, results of the control beam group will be introduced first and then the results of the rehabilitated beam groups will be compared with the control beam group in a table format. Also plots of load versus vertical mid-span deflection and failure mode at ultimate load capacity will be presented.

3.1 Results of the Control Beam Group

3.1.1 Ultimate Strength

Results of the control beam group with respect to the formation of the first vertical hair line flexural and shear cracks, the increased width of vertical flexural cracks, the ultimate load capacity and the failure mode at ultimate load capacity in addition to a comparison between their results are presented. Initially, hair line vertical flexural cracks were observed at the mid-span of the beams and by increasing the load, diagonal shear cracks in both shear spans and from both supports were started to appear, and when reaching high load values, vertical flexural cracks increased in width. Table 3 summarizes test results of control beam group.

Table 3. Test Results of Control Beam Group

Comparison Issue	Specimen Designation				Difference between Control Beams
	CB1		CB2		
	Load (kN)	% of Ultimate Load	Load (kN)	% of Ultimate Load	% of Difference
First Vertical Hair Line Flexural Crack	200	37.3%	95.3	19.5%	17.8%
Diagonal Shear Crack in Right Shear Span	238	44.4%	205.6	42.1%	2.3%
Diagonal Shear Crack in	238	44.4%	226.1	46.3%	1.9%

Left Shear Span					
Diagonal Shear Crack at Right Support	271	50.6%	232.2	47.5%	3.1%
Diagonal Shear Crack at Left Support	296	55.2%	208.8	42.8%	12.4%
Widen Width of Vertical Flexural Cracks	400	74.6%	371	76%	1.4%
Ultimate Load Capacity	536	---------	488.4	---------	---------
Average Ultimate Load Capacity	512.2				---------
Failure Mode at Ultimate Load Capacity	Pure Flexural Failure		Pure Flexural Failure		---------

3.1.2 Load versus Vertical Mid-Span Deflection
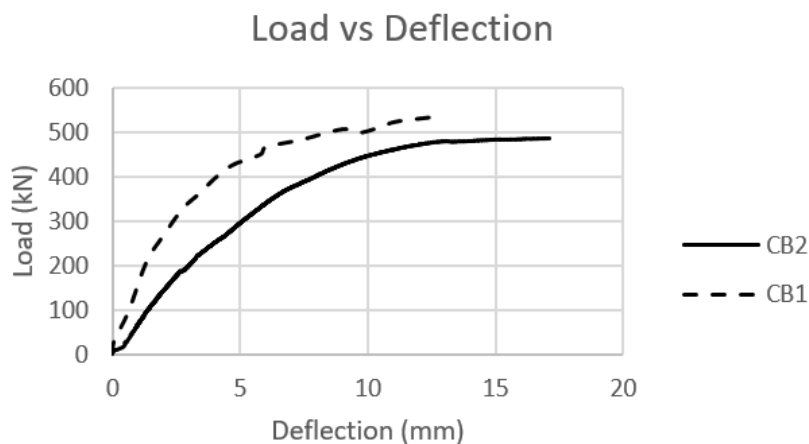
Figure 5. Comparison of Load versus Vertical Mid-Span Deflection between CB1 and CB2

According to Table 3 and Figure 5, there are some differences in the results between the two control beams, and this can be attributed to the difference in the testing machines with different load rates and the vibration process during casting might not have been the same between the two control beams since the vibration was manually undertaken due to the small spacing between stirrups.

3.1.3 Failure Modes

Before reaching the ultimate capacity, obvious widening in vertical flexural cracks at the mid-span of the beam with a rapid increase in the deflection values were observed; the latter indicates that yielding of the longitudinal reinforcement started at this stage. Both control beams failed in a ductile manner as expected. Figure 6 illustrates pure flexural failure of both control beams.

CB1   CB2

Figure 6. Pure Flexural Failure of CB1 and CB2 at Ultimate Load Capacity

3.2 Results of the Rehabilitated Beam Groups

In this section, the results of the rehabilitated beam groups are presented in a comparison with the control beams group. From the eight rehabilitated beams, two beams (RB1-2 and RB2-2) are excluded from the results due to a sudden tilt in the hydraulic jack and the specimen. Figure 7 illustrates tilting of the two excluded specimens.

Figure 7. Tilting of Specimens

The rehabilitated beams were tested under one concentrated load and in two phases; phase one (pre-cracked phase) and phase two (rehabilitated phase). Beams in pre-cracked phase were tested until the load was reached an approximate value 300 kN (i.e. 60% of the average ultimate load capacity of the control beams); and then the beams were removed and rehabilitated with MBrace laminate and MBrace Fiber 230/4900.

3.2.1 Results of Rehabilitated Beams in Pre-cracked Phase

3.2.1.1 Crack Pattern

Figure 8 shows the crack patterns (first vertical hairline flexural cracks at mid-span of the beam and diagonal shear cracks in both left and right shear spans as well as diagonal shear cracks at one or both supports in some specimens) of six rehabilitated beams.

RB1-1
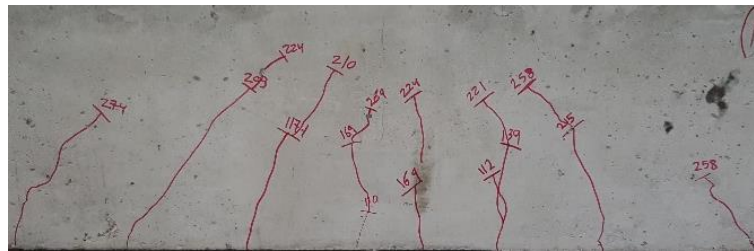
RB1-3

RB2-1
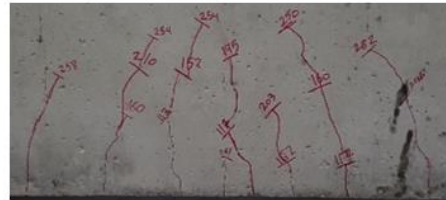
RB2-3

RB3-1

RB3-2

Figure 8. Cracks Pattern of Rehabilitated Beams in Pre-Cracked Phase

3.2.1.2 Load versus Vertical Mid-Span Deflection

A comparison in the response of load against vertical mid-span deflection between rehabilitated beams of each test group is presented in Figure 9.

Load vs Deflection
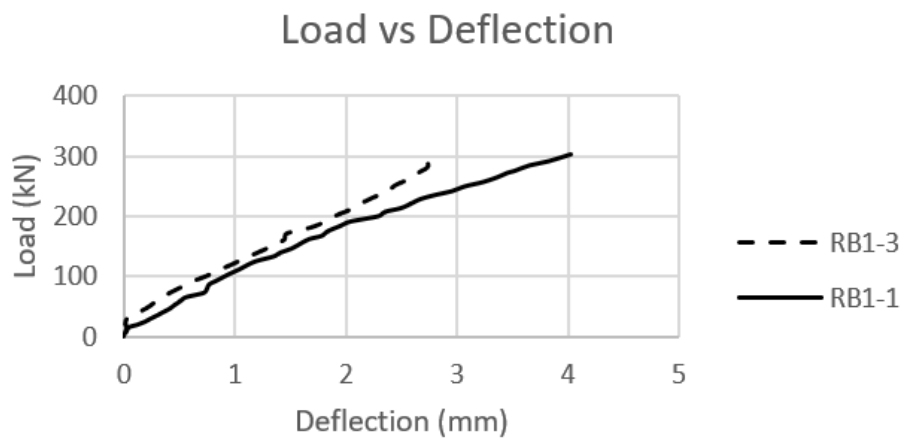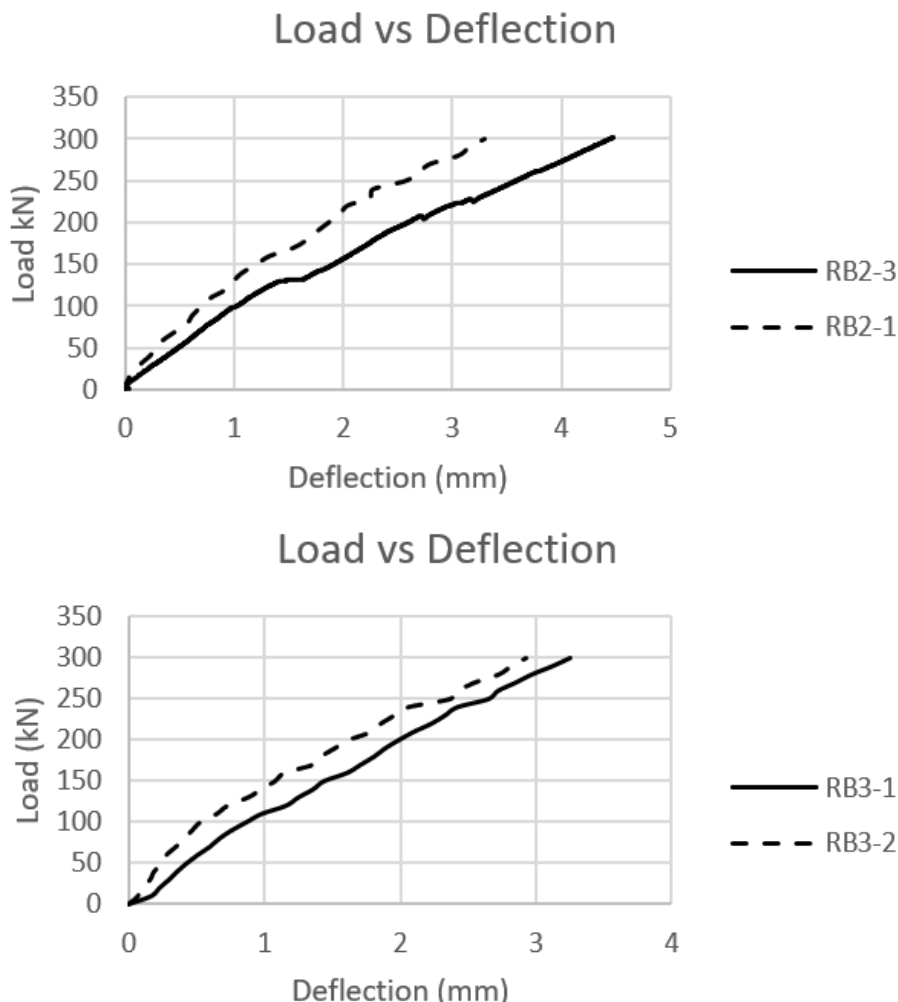
Load vs Deflection

Figure 9. Comparison of Load versus Vertical Mid-Span Deflection between Rehabilitated Beams for Each Test Group

Referring to Figure 9, the response of load versus vertical mid-span deflection of rehabilitated beams are approximately the same in the pre-cracked phase.

3.2.2 Results of Rehabilitated Beams in Rehabilitated Phase

In this phase, testing was continued after repairing the beams with MBrace Laminate and MBrace 230/4900.

3.2.2.1 Ultimate Strength

Table 4 summarizes test results of six rehabilitated beams with respect to the appearance of first vertical hair line flexural cracks, diagonal shear cracks in both shear spans and at both supports, increased width of flexural cracks, enhancements in the ultimate load capacity and the failure mode at ultimate load capacity.

According to Tables 3 and 4, there are some differences in the results between the control beam group and rehabilitated beam groups and also between beams of each group, these differences can be attributed to the difference in testing machines with different load rates and to the external attachment of CFRP to rehabilitated beams. All increased percentages of rehabilitation was with respect to the average ultimate load capacity of control beams. It is clear that there was no improvement in the percentage of rehabilitation in the 3rd test group; which means that scheme of CFRP used in this series is not effective in this test group in enhancing ultimate load capacity of rehabilitated beam with respect to the average ultimate load capacity of control beams. Another issue regarding the enhancement of ultimate load capacity, it is obvious from the test results that the enhancement of CFRP to the load carrying capacity ranged from 2.9% to 13.1% of rehabilitated beams in the 2nd and 4th test group.

Table 4. Test Results of Six Rehabilitated Beams

Comparison Issue	Specimen Designation											
	RB1-1		RB1-3		RB2-1		RB2-3		RB3-1		RB3-2	
	Load (kN)	% of UL	Load (kN)	% of UL	Load (kN)	% of UL	Load (kN)	% of UL	Load (kN)	% of UL	Load (kN)	% of UL
First Vertical Hair Line Flexural Crack	103.7	18.5	93	17.6	120	23.3	113	21.4	120	20.7	120	21.9
Diagonal Shear Crack in Right Shear Span	199	35.5	234	44.4	180	35	230	43.6	220	38	200	36.6
Diagonal Shear Crack in Left Shear Span	213.2	38	192.4	36.5	180	35	230	43.6	250	43.2	200	36.6
Diagonal Shear Crack at Right Support (After/before) Reh.	302.9 Bef.	54 Bef.	258 Bef.	48.9 Bef.	250 Bef.	48.6 Bef.	196 Aft.	37.1 Aft.	250 Bef.	43.2 Bef.	300 Bef.	54.8 Bef.
Diagonal Shear Crack at Left Support (After/before) Reh.	390 Aft.	69.5 Aft.	274 Bef.	52 Bef.	280 Bef.	54.4 Bef.	246 Aft.	46.6 Aft.	250 Bef.	43.2 Bef.	300 Bef.	54.8 Bef.
Widen Width of Flexural Cracks	500	89.1	485	92	400	77.7	433	82	-------	-----	-------	-----
Ultimate Load Capacity	561.3	-----	527.1	-----	541.6	------	528.1	------	579.1	-----	547	-----
% of Reh.	9.6		2.9		0.47		3.1		13.1		6.8	
Failure Mode at UL. Capacity	Pure flexural failure with debonding of CFRP		Pure flexural failure with peeling off concrete from both supports		Pure flexural failure with peeling off concrete from both ends of laminate CFRP				Pure flexural failure with rupture and partial delamination of sheet CFRP			

3.2.2.2 Load versus Vertical Mid-Span Deflection

This section will introduce a comparison in the response of load-deflection curve between control beams and rehabilitated beams of each group.

Load vs Deflection

Load vs Deflection
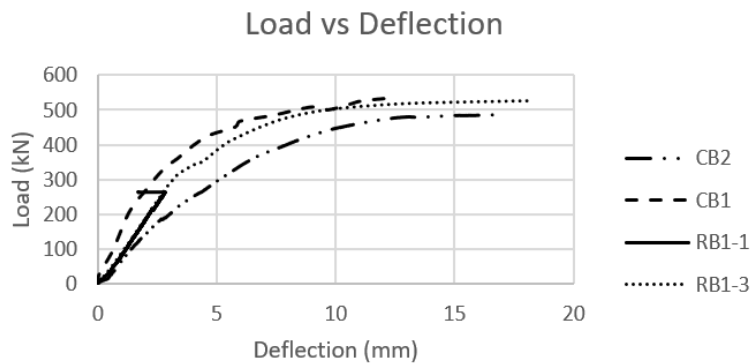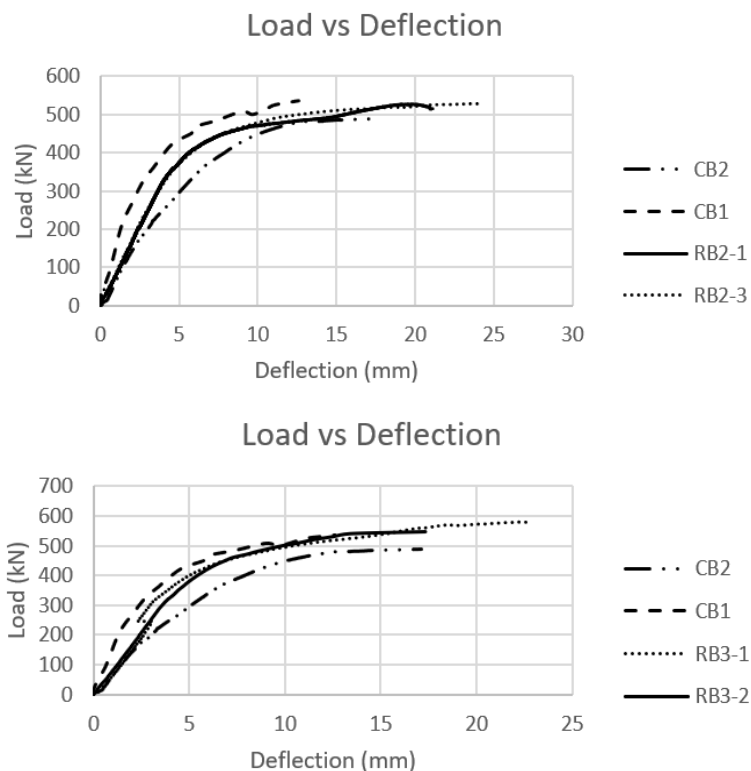

Load vs Deflection

Figure 10. Comparison of Load versus Vertical Mid-Span Deflection between the Control Beam Group and the Rehabilitated Beam Groups

Referring to Figure 10 and regarding RB1-1, the deflection values were taken until the load reached 265.5 kN because after this reading debonding of CFRP occurred from the middle of the beam and the testing was continued by taking load values only. It is obvious that there was improvement in the response of load-deflection curve of the 2nd and 4th test groups in comparison to the average response of the control beams and this was due to the external attachment of CFRP to the rehabilitated specimens.

According to Figure 10, the response of the load-deflection curve of the 3rd test group was approximately the same as the average response of the control beams, which indicates that scheme of CFRP used in this case has no significant effect in the 3rd test group.

3.2.2.3 Failure Modes

In this section the failure mode of each rehabilitated beam is presented. The first beam of the 2nd test group failed in pure flexure with debonding of laminate CFRP whilst the second beam failed in pure flexure with an additional peeling of the concrete from both supports. Beams of the 3rd test group failed in pure flexure with peeling of the concrete from both ends of the laminate CFRP. Regarding the 4th test group, both beams failed in pure flexure with rupture and partial delamination of CFRP sheet. When failure of RB3-1 and RB3-2 was reached at ultimate load capacity; the CFRP sheet was removed to see exact failure mode of these beams. Figure 11 shows the failure modes of the rehabilitated test groups.
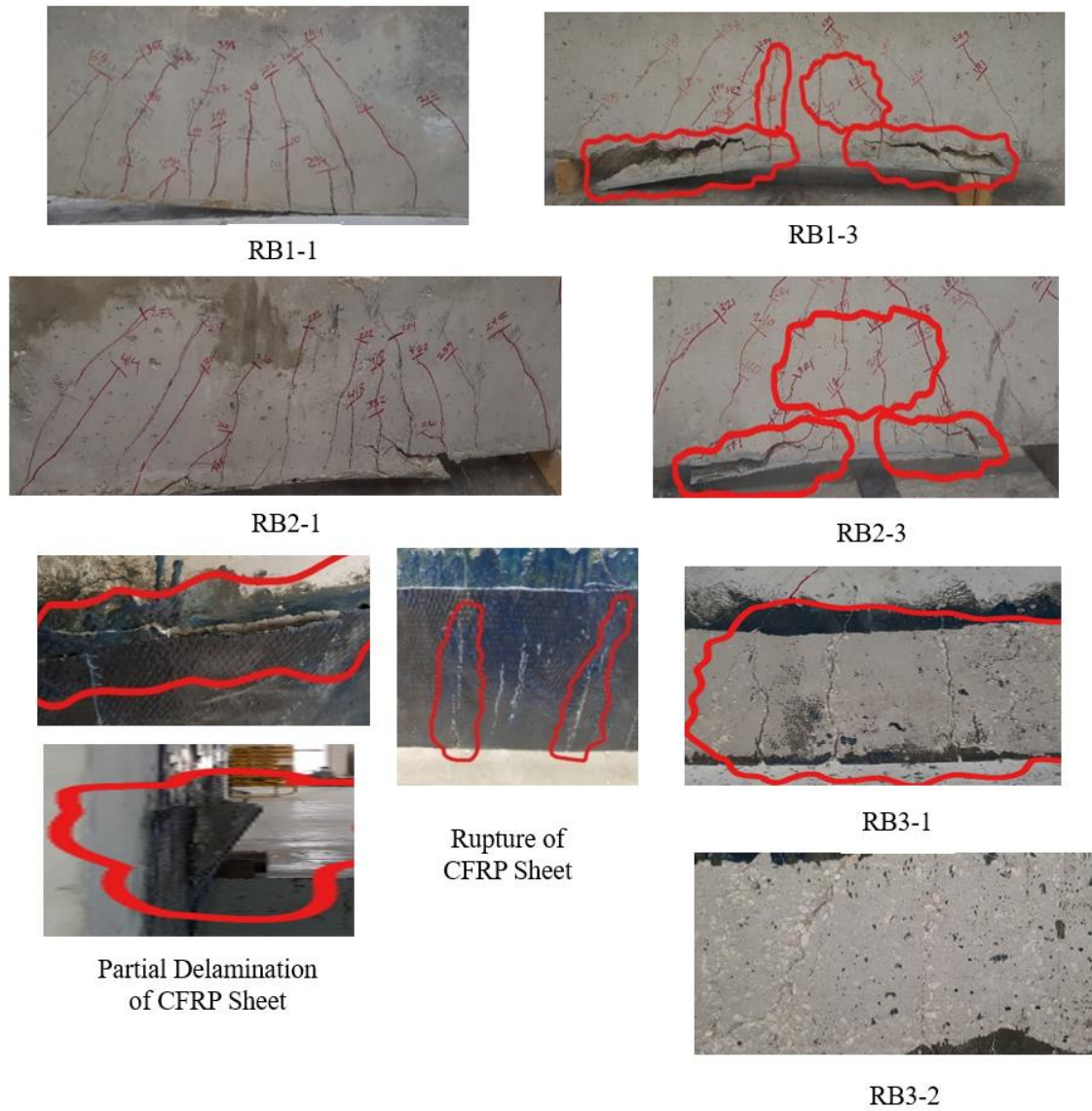
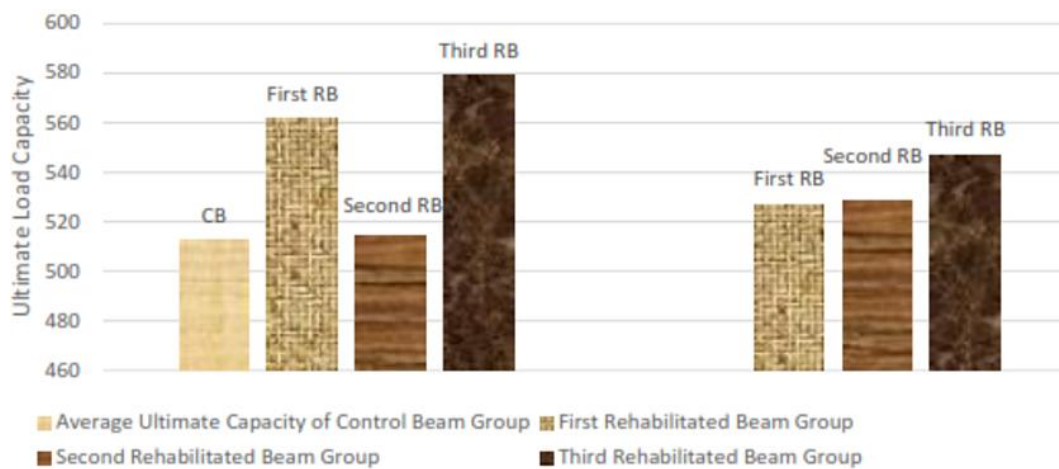Figure 11. Failure Modes of Rehabilitated Test Groups

Figure 12. Results Summary Illustration

3.3 Summery

Figure 12 illustrates the enhancement in ultimate load capacity of each rehabilitated beam with respect to the average ultimate load capacity of control beams.

Referring to Figure 12, it is obvious that the results of rehabilitation in the 2nd and 4th test groups are close to each other, but with taking into the account the high cost of CFRP material, scheme of CFRP material in the 4th test group is more effective over the 2nd test group.

4. Conclusions

According to the experimental results of retrofit deep beams by using CFRP, the following conclusions were arrived at:

1. Externally bonded CFRP to pre-cracked beams delays the occurrence of diagonal shear cracks at both span ends as well as enabling an increased width of the vertical flexural cracks of rehabilitated beams to be acceptable compared to the control beams.

2. Both CFRP laminates and sheet retrofitted deep beams showed a significant increase in the ultimate load carrying capacity in reference to the control beam. The enhancement magnitude of retrofitted deep beam ranged from 2.9% to 13.1%.

3. Tests showed that the 2nd group using CRFP laminates showed a remarkable load carrying capacity increase when compared to the 3rd test group.

4. When varying the length of laminate and keeping all other variables unchanged (i.e., the 2nd and 3rd groups), the use of full length between supports proved to be more effective in increasing the load carrying capacity when compared to the use of partial length laminates.

5. External bonding of CFRP to pre-cracked beams enhances the load carrying capacity when compared to control beams. Enhancement of load carrying capacity in the 2nd test group (i.e., the laminate group) was 9.6% for RB1-1 and 2.9% for RB1-3, while for the 4th test group (i.e., the sheet wrapped group) was 13.1% for RB3-1 and 6.8% for RB3-2.

6. According to the results of this study, the more effective scheme of CFRP in enhancing flexural performance of simply supported RCDBs is CFRP wrapped sheets (i.e. the 4th test group).

5. Recommendations and Future Works

▪ Regarding test results of this study, more researches and studies are required for rehabilitation of RCDBs with more schemes of CFRP laminates and sheets in order to improve flexural performance of RCDB in old, new, and existing buildings and bridges.

▪ More schemes of CFRP composites are required for rehabilitation of RCDBs to improve flexural performance. External attachment of CFRP is required not only from the tension face of the beam, but also from both sides of the beam in order to improve flexural performance and to avoid debonding of CFRP composites.

▪ Finite element analysis is recommended for rehabilitation of RCDBs with CFRP composites by using ANSYS or ABAQUS software.

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